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Three Essays on Cross-Border Movements

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Three Essays on Cross-Border Movements

by

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Three Essays on Cross-Border Movements

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This dissertation studies migration and remittances through a macroeconomic framework. In the first chapter, I compare the impact of national and regional borders on the migration decisions of agents. Migration between regions within a country is observed to be higher than migration between countries; moreover, both types of migration respond similarly to differences in economic opportunities. These observations are analyzed with the aid of a symmetric two-country dynamic general equilibrium model with labor mobility. The model is solved using dynamic programming and estimates of the latent cost of crossing borders are obtained through the method of simulated moments. The results show that the mean moving cost associated with crossing an international border is more than twice that of crossing a regional border. One important consequence of this high cost is that the mere presence of a national border decreases aggregate welfare by about 0.15% in terms of annual consumption for countries such as Sweden and Denmark. In the second and third chapters, I analyze how remittances by emigrants to their home countries affect welfare, consumption, savings, investment and

the structure of production between traded and non-traded sectors in developing economies. For both these chapters, I solve a macroeconomic model with an endogenous remittance decision. However, while the second chapter considers remittances driven by investment or savings motives, the third chapter considers altruistic remittances.

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The Cost of a Border in a Model of Aggregate Fluctuations

This paper compares the impact of national and regional borders on the migration decisions of agents. Data from Denmark and Sweden indicate that even in the absence of legal restrictions on cross-border movements of workers, migration between regions within a country is considerably higher than migration between countries; moreover, both types of migration respond similarly to differences in economic opportunities. These observations are analyzed with the aid of a symmetric two-country dynamic general equilibrium model with labor mobility. The model is solved using dynamic programming and estimates of the latent cost of crossing borders are obtained through the method of simulated moments. The results show that the mean moving cost associated with crossing an international border is more than twice that of crossing a regional border. One important consequence of this high cost is that the mere presence of a national border decreases aggregate welfare by about 0.15% in terms of annual consumption for countries such as Sweden and Denmark. The results also underscore the importance of explicitly considering the higher costs associated with crossing national borders while estimating potential welfare gains from the opening of borders. In a counterfactual example involving Denmark and Sweden, gains from an open border are overestimated by about 18% when border costs are ignored.

1 Introduction

Empirical evidence suggests that while choosing where to live and work, individuals are greatly influenced by their economic prospects in various locations. Blanchard and Katz (1992) and Kennan and Walker (2006) are two papers, among many that establish this link. Aggregate trends in migration are the collective consequence of all the individual decisions. These aggregate changes in labor due to migration in turn have a significant impact on the economic prospects of the regions under consideration. Thus, to understand both individual migration decisions and the impact of overall migration on an economy, it is essential to establish a sound understanding of the main factors that influence migration.

The presence of a national border appears to play a huge role in the migration decision of agents even when there are no legal restrictions to the cross-border movement of labor. A national border is often more than just a man-made line drawn on a map to demarcate territories and jurisdictions. Crossing a border could involve a change in language, currency, labor and retirement security, regulations, governments, socio-cultural environment, geography etc. and any or all of these factors can influence the migration decision of agents. Regional borders may also involve a similar transition, although often with a much smaller magnitude of difference.

To study the difference between regional and national borders, it is essential to have inter-country and inter-region migration data for a pair of countries that allow free movement of labor across one another. By comparing inter-region data to inter-country data, one can estimate the true effect of national border.

Denmark and Sweden form one such country pair. Denmark and Sweden are both part of the Nordic Common Labor Market established in 1954. Moreover, Denmark and Sweden are similar countries: Danish and Swedish are mutually intelligible languages and both share a common Scandinavian heritage. They have similar economies and political regimes and their climactic conditions are not too dissimilar. Although there are some differences between the two countries in terms of culture, currency etc., both are very similar to each other, particularly when compared to other pairs of bordering countries around the world. Since the two countries are so alike, one can attempt to isolate the impact of national border on migration decisions by comparing migration between Denmark and Sweden to migration across regions of Denmark.

In line with other studies, empirical work reported in this paper suggests that migration across Denmark and Sweden is indeed influenced by economic conditions. While there are also notable trend effects to migration, the data show that aggregate migration in each period responds closely to fluctuations in aggregate business activity in the two countries.

From Figure 1 it can be seen that the difference between the growth rate of migration from Denmark to Sweden and the growth rate of migration from Sweden to Denmark is significantly correlated with the difference between the growth rate of Swedish GDP per worker and the growth rate of Danish GDP per worker. This is intuitive - in periods when the economy in Sweden is booming relative to the economy in Denmark, there is a boom in the number of migrants from Denmark to Sweden relative to the number of migrants from Sweden to Denmark. In other words, the data suggest that migrants respond to economic conditions by moving in larger numbers to the country experiencing the relative boom.

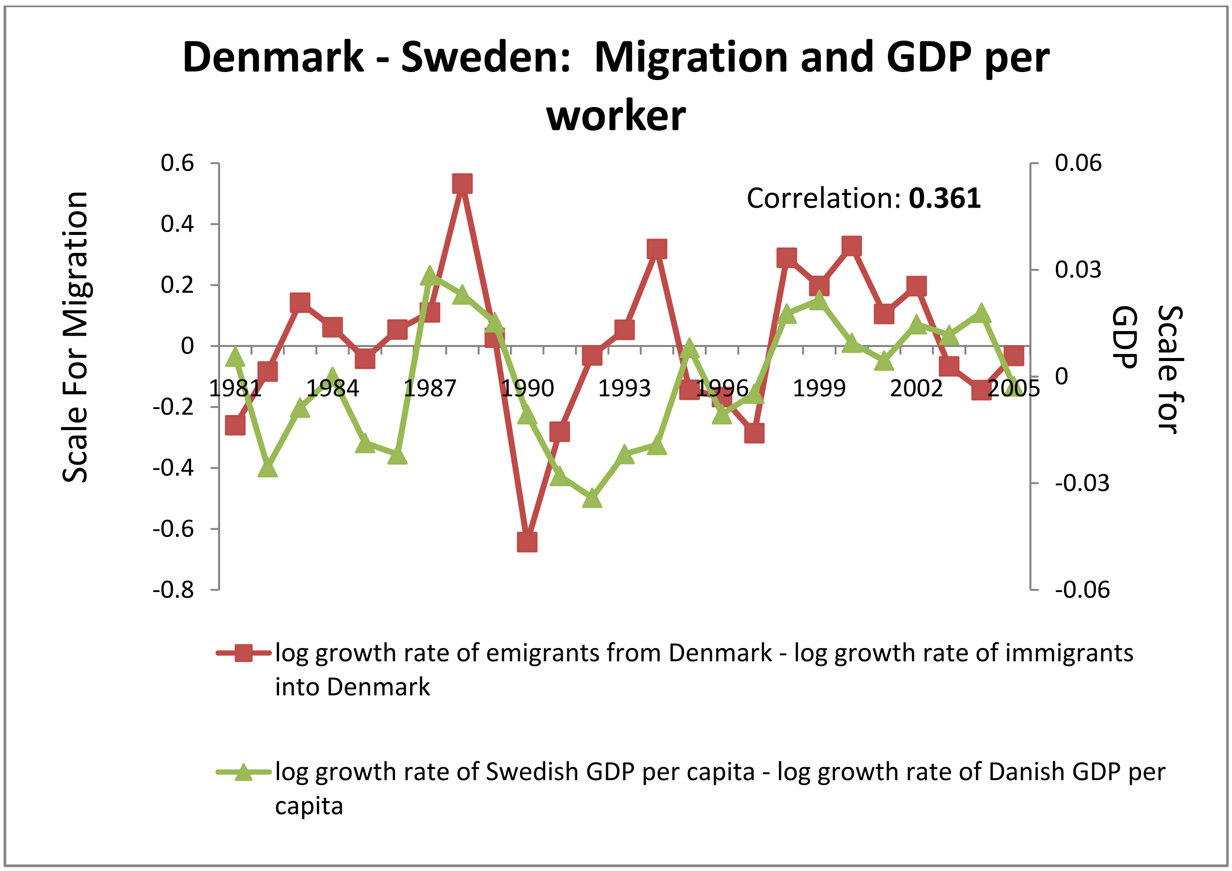


Figure 1

Figure 2 shows that a similar statement can be made about migration within Denmark where the provinces of Denmark have been aggregated to form two distinct territories - East and West Denmark (the former includes the regions of North Jutland, mid Jutland and South Denmark while the latter consists of the capital region of Denmark and Zealand). If East Denmark is experiencing a boom relative to West Denmark, there is also a boom in the number of migrants from West Denmark to East Denmark relative to the number of migrants from East Denmark to West Denmark.

These two figures indicate that both Danish and Swedish international migrants as well as East and West Danish inter-regional migrants respond to differences in GDP at business cycle frequencies.

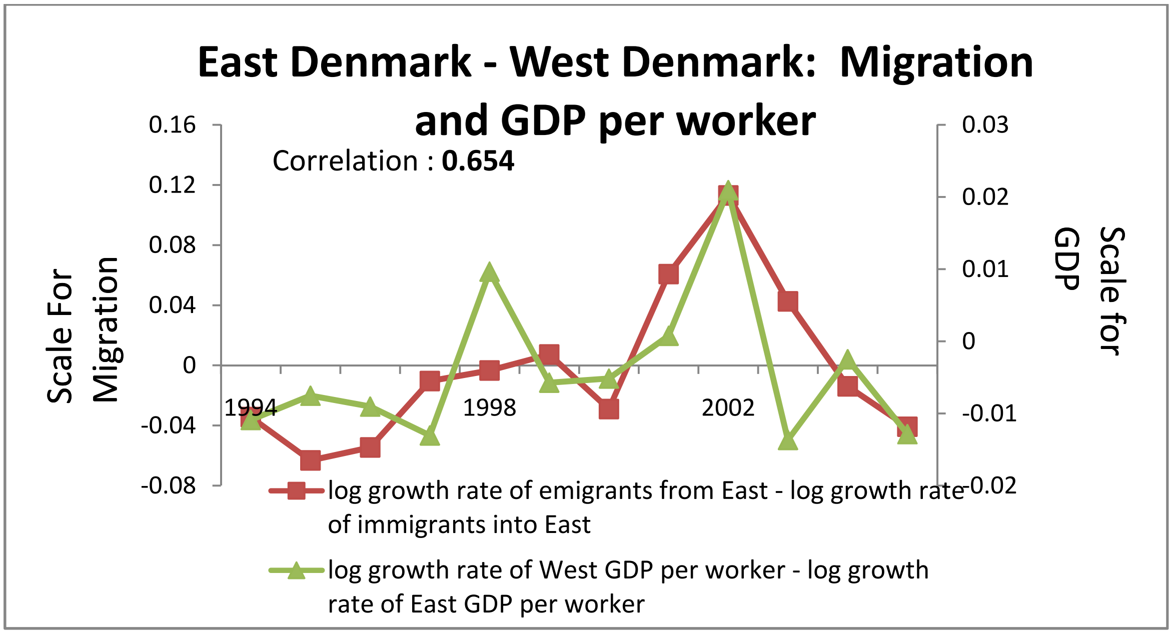


Figure 2

However, in terms of magnitudes the number of inter-regional migrants far outweighs the number of international migrants as a fraction of the labor force. Figure 3 shows that despite the similarities between the two countries, inter-regional migration in Denmark is far greater than international migration even though in both cases, migrants respond similarly to differences in GDP per worker.

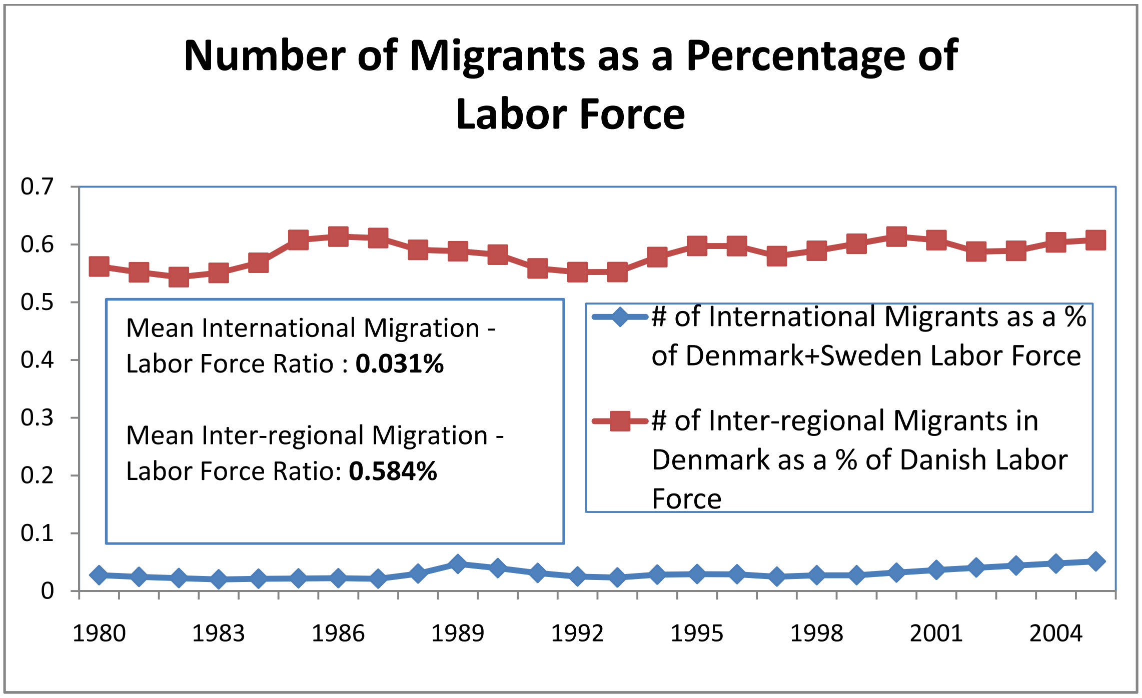


Figure 3

The main features of the data displayed in Figures 1, 2 and 3 are summarized in Tables 1 and 2. As can be seen, the correlations for international and inter-regional migration are positive and significant with respect to per capita GDP growth rate while the difference in the percentage of international and interregional migration is substantial.

Correlation between Net Log Growth Rate of Immigration and Net Log Growth Rate of GDP per worker	
Denmark and Sweden	**0.361***
East Denmark and West Denmark	**0.654****

* significant at 10%

** significant at 5%

Table 1

These enormous differences in the number of inter-regional and international migrants suggest that there might be a latent cost associated with crossing a border even in the absence of policy restrictions and significant lingual and socio-cultural barriers. Such a cost could be indicative of a 'home bias' for labor supply, just as there is evidence for home bias in goods, assets etc. Home bias can loosely be defined as an observed tendency of agents to disproportionately use goods, assets etc. belonging to their home country. Home bias for labor supply is hardly surprising as agents might prefer to remain in their country of residence and crossing borders may involve significant costs. This implies that the presence of home bias also raises the possibility of borders having an adverse effect on aggregate welfare. Moreover, if home bias does exist, ignoring it while modeling potential migration can lead to an overestimation of welfare gains as migrating across borders may involve a sizeable inherent cost.

Number of Total Migrants as a Percent of Total Labor Force	
Denmark and Sweden	**0.0306** (0.0018)
East Denmark and West Denmark	**0.5841** (0.0043)

Standard errors are in parentheses

Table 2

This paper analyzes the difference between international and inter-regional migration in quantitative terms with the aid of a simple two-country dynamic general equilibrium model of migration and GDP driven by differences in exogenous productivity shocks. The model is first estimated for Denmark and Sweden and the results are compared with a similar analysis conducted for regions within Denmark. I find strong evidence for a significant cost associated with migrating across national borders. The cost of crossing an international border for the average migrant is almost double the corresponding cost of crossing a regional border. When considering the migration costs paid by the marginal mover, the evidence in support of border effects becomes even more apparent, particularly for old agents. Thus, borders do have a deleterious effect on welfare; the presence of a national border decreases welfare by about 0.15% of annual consumption. Ignoring such high border costs can result in an overestimation of the welfare from open borders by about 18% even for countries as similar as Denmark and Sweden.

1.1 Related Literature

This paper relates to international migration, regional migration and 'home bias' - three somewhat distinct strands of literature. Many papers that focus on international labor movements deal with migration from countries with low total factor productivities to countries with high total factor productivities. This paper on the other hand, studies labor migration across similar economies. In this respect, it is closer to papers that study regional migration within countries – in fact one of the models tested here pertains directly to regional migration. By using a common framework to analyze both regional and international migration, this paper estimates the effect of a national border on migration decisions. Thus it connects to the literature on home bias even though such a bias for labor supply is intuitive and easily explained as agents might prefer to remain in their home country and crossing borders could entail significant costs. Various papers have documented the home bias for goods, savings, assets etc. This paper too contributes to this literature by estimating a measure for home bias in labor by computing the difference between a regional border and a national border in the context of labor migration.

Among papers on international migration, Borjas (1995), Walmsley and Winters (2003) and Moses and Letnes (2004) quantify the effects of labor migration in a static setting. Urrutia (1998), Ben-Gad (2003) and Klein and Ventura (2006, 2007) examine mobility in a dynamic setting, as does this paper. However, these other papers study the topic of migration across countries with different levels of Total Factor Productivity or development (or study only the inflow – such as Ben-Gad, 2003). These approaches provide a good insight into the economic costs of migration restrictions or the economic effects of actual migration, but do not provide much insight into how national borders differ from regional borders with respect to migration, the key question motivating this paper.

Many of the important papers on regional migration use micro data and are hence able to identify demographic and other individual–level factors that play a role in the migration decisions of workers. Greenwood (1997) and Cushing and Poot (2004) provide a good survey of this literature. Kennan and Walker (2006) estimate a structural dynamic model to estimate moving costs and explain across-state migration decisions for agents in the United States. Another paper involving a structural microeconomic model is Bayer and Juessen (2006) in which, once again, the authors compute migration costs across US states. Davies, Greenwood and Li (2001) also uncover inter-state migration costs for the US through an empirical study using a multinomial logit model. However none of these papers analyze international labor migration to explain how regional borders differ from international ones in terms of migration costs.

Home bias too has been examined by a number of papers in various contexts. This paper is closest in spirit to Mc Callum (1996) who uncovers the home bias in trade by estimating the effect of a national border through a model in which the internal trade **within** US and Canada is compared to international trade **between** US and Canada. This paper is similar since it compares internal migration **within** Denmark to international migration **between** Denmark and Sweden. Other approaches are adopted by Feldstein and Horioka (1980) who study the home bias in savings and French and Poterba (1991) who address the home bias in equity portfolios.

The next section describes the data used to estimate the model. In Section III, I set up the model and discuss its theoretical features. I present the results of the estimation in Section IV and conclude the paper in Section V by discussing the results, conducting welfare analyses and other informative exercises; finally, I outline the avenues for possible future work on this topic.

2 Examining the Data

For this paper I use data from Statistics Denmark (international emigration and immigration, regional emigration and immigration, regional GDP) and OECD Statistics (Danish and Swedish National GDP and Labor Force).

Denmark and Sweden present themselves as a great source of data to answer the question raised in this paper. As discussed in the previous section, Denmark and Sweden are both part of the Nordic Common Labor market established in 1954. However, Denmark and Sweden had already ratified the first Nordic Labor Market treaty eight years earlier, in 1946. Moreover, the Nordic Social Security Convention was signed in 1955 to further promote migration by ensuring that Nordic governments treat immigrants from other Nordic countries just like their own citizens in terms of social security. Thus, Nordic immigrants in any other Nordic country have free access to extended services in health and insurance as well as the same unemployment benefits and state pension as the corresponding Nordic citizens. Further, moving from one Nordic country to another does not affect the number of years of contribution to supplementary pension entitlements (Nord 1996:2, p 121). With all regulatory barriers removed[1], the dataset can help isolate the cost of the border between Denmark and Sweden.

Another advantage of choosing Denmark and Sweden for the data is that there is very little cross-border commuting between the two countries. Until the building of the Oresund Bridge in 2000, the only link between the countries was either by air or an almost hour-long journey by hovercraft. As much of the data used for this paper precedes the opening of the bridge, and as no structural break in the data was observed in 2000, cross-border commuting was assumed to be insignificant for this study.

[1] Although Denmark and Sweden are both EU members, they have different currencies - this could be considered a regulatory barrier

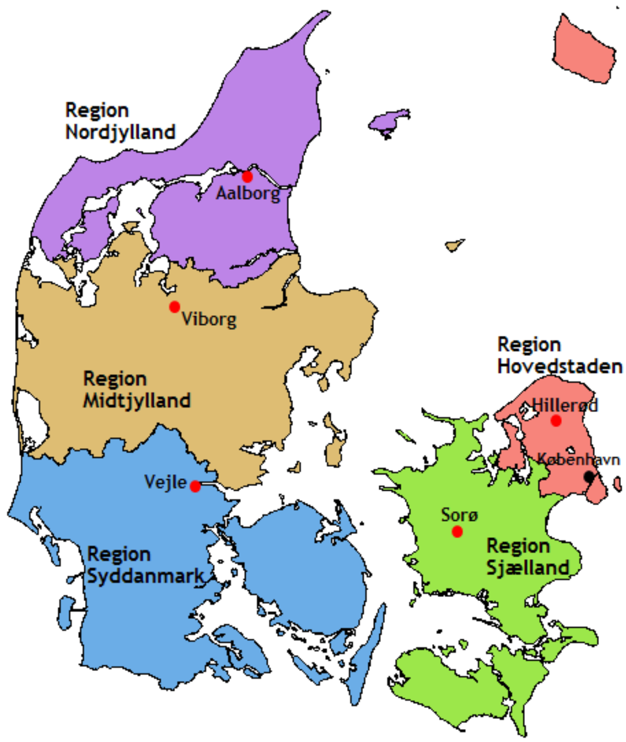


Figure 4

To understand the cost of a border, it is essential to be able to compare it to the cost of moving in the absence of a border. For this, migration within Denmark can be conveniently used. Although Denmark was divided into numerous counties, in January 2007, under the Danish Municipal Reform, five new administrative units were created to replace the country's traditional thirteen counties.

In order to study inter-region migration using the same sparse model as the one used for inter-country migration, for the purpose of this paper, these five regions were further grouped into two larger regions - East Denmark (comprising Nordjylland, MidtjyJland and Syddanmark) and West Denmark (comprising Hovedstaden and

Sjaelland). As can be seen from the Danish map in Figure 4, this grouping of regions appears natural in terms of migration and geography. East and West Denmark are connected only at specific transit points with bridges (and ferries before the building of bridges such as the Great Belt Fixed Link in 1997 which connects South Denmark to Zealand). Again, this judicious choice of regions minimizes the number of possible commuters. Moreover even if inter-regional commuting is significantly under-measured in these data, it would bias results in favor of the principal argument of this paper. It would imply that agents are even more willing to cross regional borders as compared to national borders (across which commuting is not significant) and that would entail even larger differences between regional and international migration costs.

All the migration data used in this paper are from the Central Population Register of Denmark. Illegal migration is not a concern for this choice of countries and this dataset. Moreover, rather than estimations from samples, the data uses the true population values. Also, since the same data source is used for both regional and international migration, the definitions are standard and the data are comparable with each other.

One feature that stands out in the data is that young people tend to migrate much more than older people. As can be seen in Figure 5 and 6, this is consistently true both in each period and over time for Denmark-Sweden as well East Denmark-West Denmark migration.

To include this feature in the analysis while retaining a sparse model, the population of each country (and region) was divided into two groups - young and old. Those below 35 years of age were assumed to be young and those above were assumed to be old. 35 was chosen as a cut-off since for both Denmark-Sweden migration and for East-West migration, no five year aggregation of ages above 35 accounted for more than 12% of the migrants in any year.

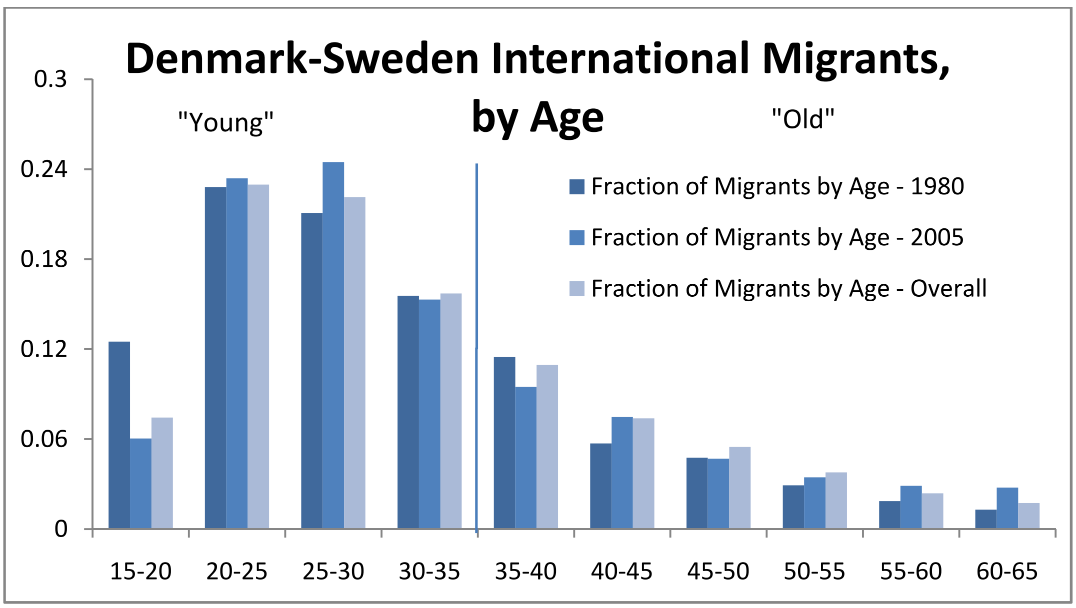


Figure 5

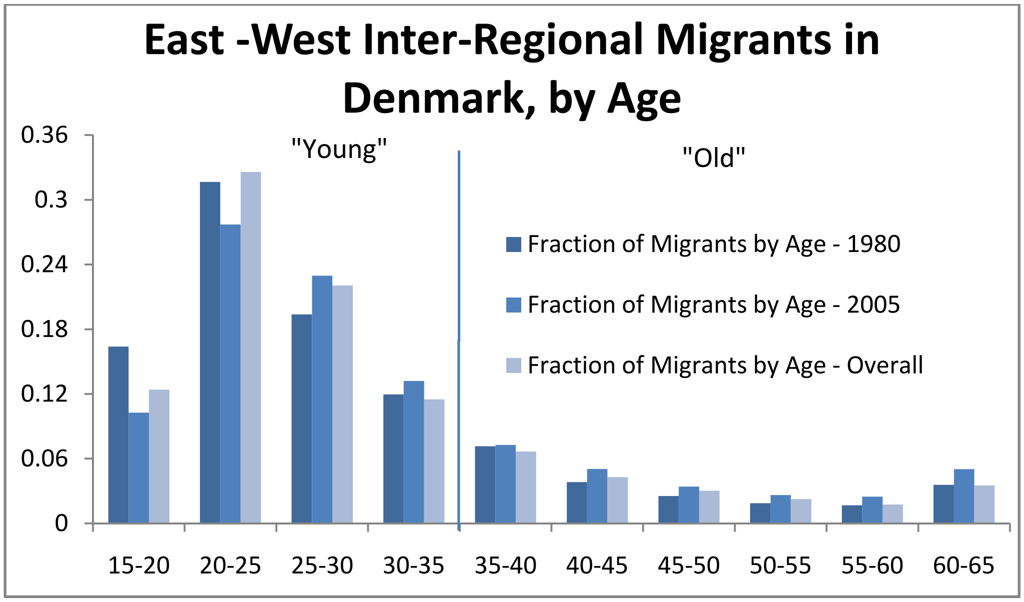


Figure 6

As can be seen in Figures 7 and 8, there continues to be a significant correlation between the migration of young people and GDP per worker just as there was for overall migration and GDP per worker in Figures 1 and 2. And again, as with Figure 3, the huge difference in the percent of inter-regional movers and international movers persists for both groupings of age. This can be seen in Figures 9 and 10. Also, it can be noted by comparing across the two graphs that the percent of old movers for both international migration and inter-regional migration is considerably less than the corresponding counterpart for the young movers.

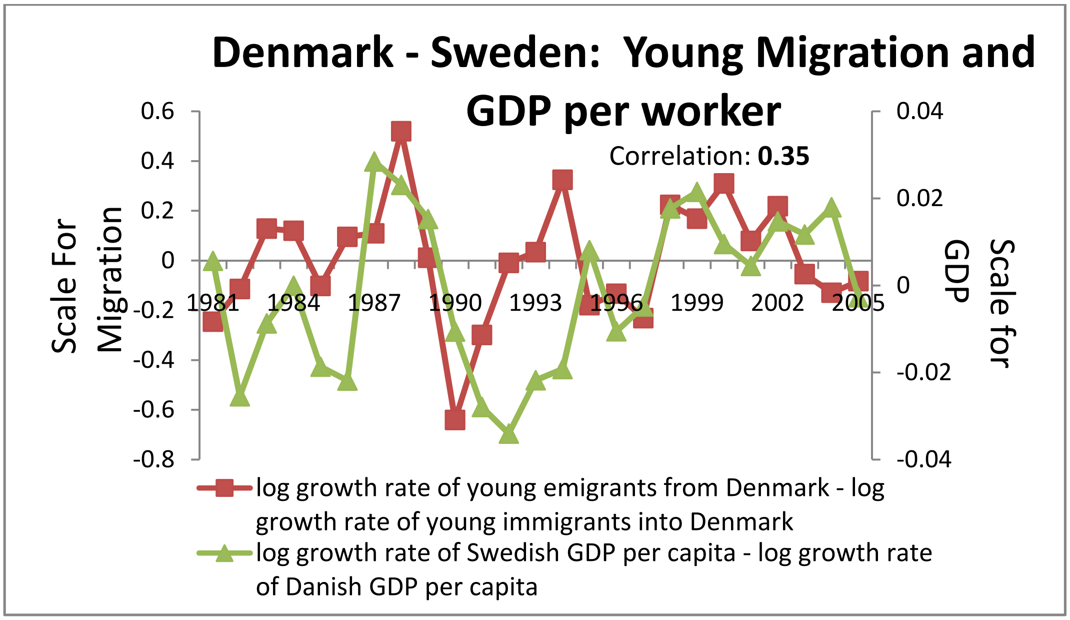


Figure 7

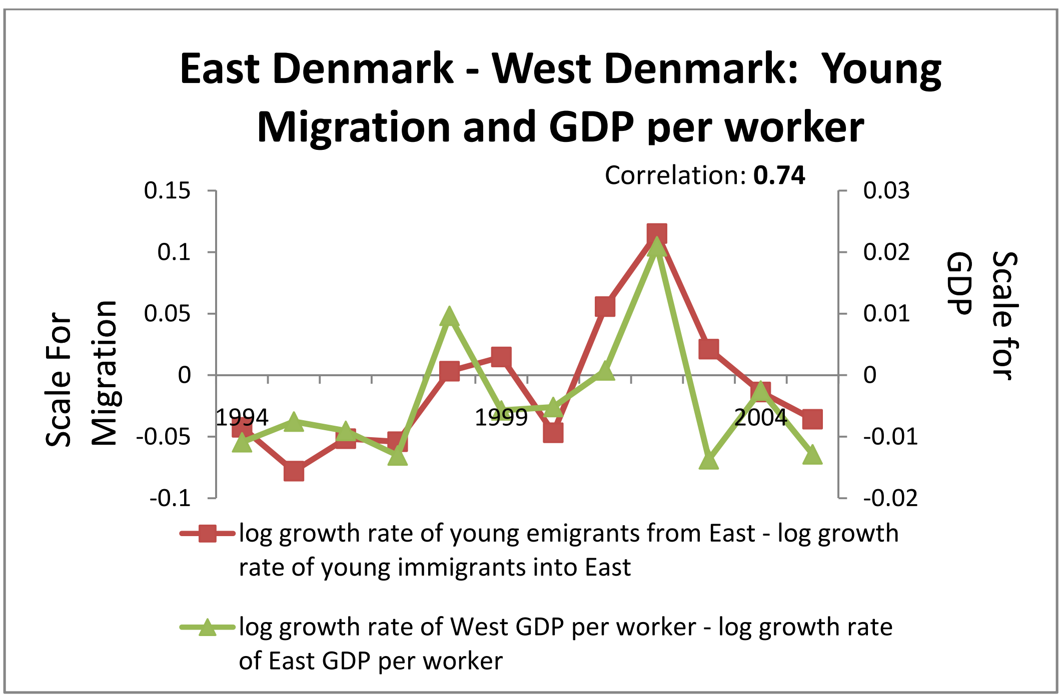


Figure 8

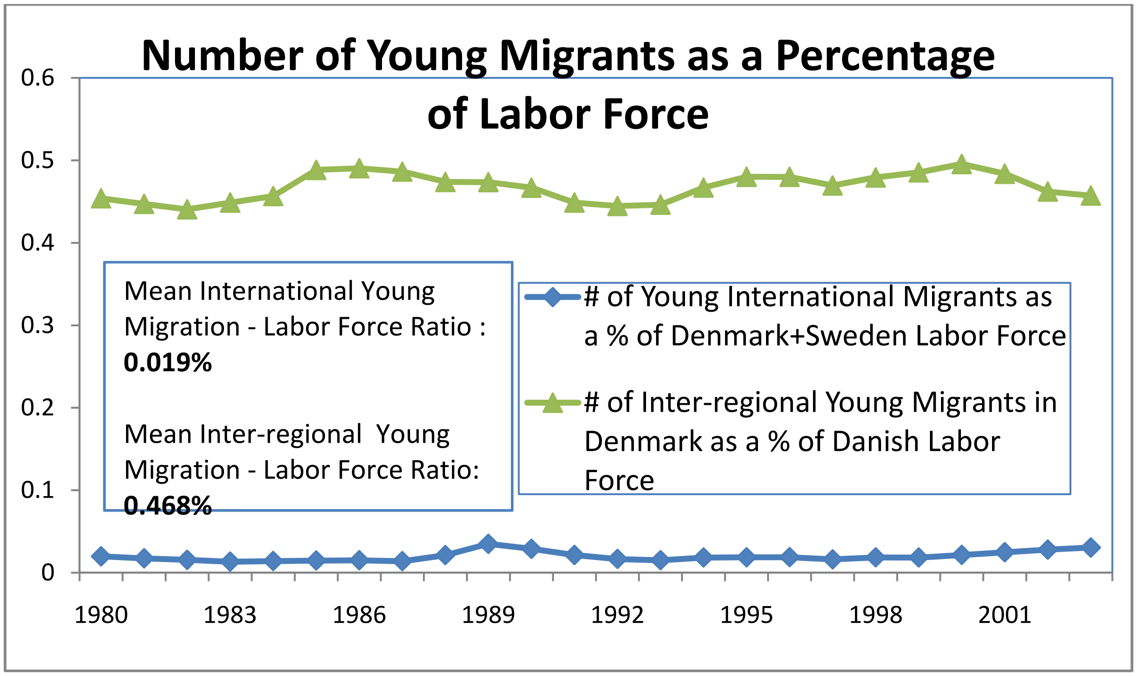


Figure 9

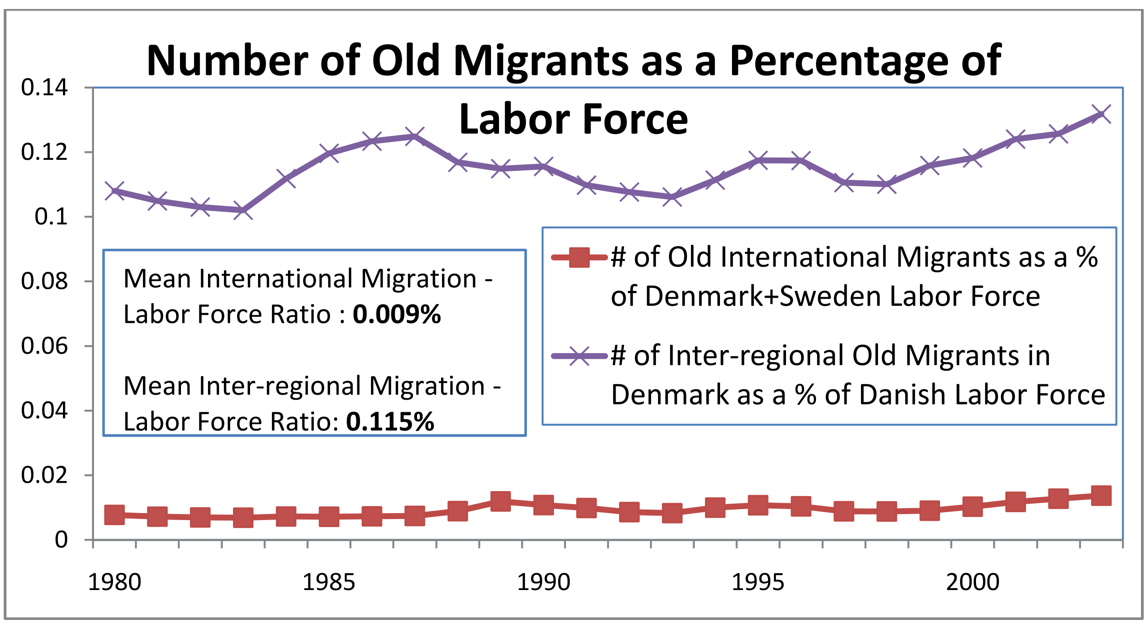


Figure 10

Another interesting feature of the data is the high proportion of 'reverse migrants'. Reverse migrants can be defined as the movers from a country experiencing a relative economic boom to the other country. Despite the significant correlation between GDP growth and Migration growth, a large number of migrants each period move in the counter-intuitive direction. This finding is consistent for both Denmark-Sweden migration and East-West migration. Table 3 shows that for both international and inter-region data, the fraction of migrants who are reverse migrants is very high (greater than 0.4) and the standard deviation for this fraction is also very low. Any model that aims to explain migration should be able to accommodate this finding as well.

Fraction of Migrants who are 'Reverse Migrants'	
Denmark and Sweden	**0.4364** (0.0097)
East Denmark and West Denmark	**0.4599** (0.0053)

Table 3

Standard errors are in parentheses

3 Model

The data is analyzed using a two-country dynamic general equilibrium model with a continuum of old and young agents who are heterogeneous in terms of their realized moving cost each period. As the question is specifically targeted towards migration, a two-country setting was deemed appropriate. A general equilibrium framework is useful for estimating the overall cost of moving across a border. While a static framework can provide intuition, a dynamic model is required to properly estimate moving costs as the former cannot capture the differences between the response of migration to transient and persistent shocks to TFP. In the model, the only source of aggregate uncertainty is the TFP shock. Each period, every agent faces an idiosyncratic moving shock and an idiosyncratic aging shock, but as the distributions of these shocks are invariant over time and as there is a continuum of agents densely populated over both distributions (for the moving shocks and age), these do not lead to any aggregate uncertainty. Labor is the only input required for production, there is no storage technology and savings are possible only through Arrow Securities.

The model is first estimated with Denmark and Sweden as the two economies and then estimated again with East and West Denmark as the two economies. The difference in the results is then used to measure the effects of a national border.

3.1 Agents

As the data shows distinct age effects, the model too allows for two types of agents - young and old. The essential features of age effects can be captured with just two types of agents and allowing more types will reduce the sparseness of the model. For ease of computation, all agents are assumed to be infinitely lived and age in a Markov fashion - young agents get old with a certain probability (1-α) each period and old agents die with a certain probability (1-π) each period. Old Agents who die are replaced by an identical number of young agents who receive all the bequests of the old agents. As with standard infinitely lived agent models, agents in this model too are perfectly benevolent across generations. The total population size as well as the distribution of ages is assumed to be constant over time. In other words, the number of young people who become old each period is equal to the number of old people dying and getting replaced by their young counterparts.

3.2 Preferences

Agents have time separable, constant relative risk aversion preferences over a composite good that includes the consumption good, possible disutility from moving and disutility from labor. In an alternate and mathematically equivalent specification, the composite good consists only of the consumption good and disutility from labor, while the moving cost is paid in the form of resources in the budget constraint. Although mathematically equivalent, the two specifications are not observationally equivalent as resource costs can be measured unlike psychic costs.

The instantaneous utility is given by the function below. Depending on the variation considered, C could include just resources or a combination of resources and disutility from moving as discussed below. n is the labor supplied while ω is 1+ the inverse of the inter-temporal elasticity of labor substitution and γ is the coefficient of relative risk aversion.

$$U(C,n) = \frac{(C - \frac{n^{\omega}}{\omega})^{1-\gamma} - 1}{1-\gamma}$$

CRRA preferences with the composite good comprising the consumption good and disutility from labor are common in the Business Cycle literature (see for instance, Schmitt-Grohe and Uribe (2003) and Greenwood et al. (1988) for examples). A case could be made for including the moving cost in the utility function as people may prefer to stay in one country rather than another and this may be the underlying reason for the moving cost. Alternatively, it could be argued that the moving cost is caused by an actual depletion of resources incurred while moving. As shown later in this section both can be considered equivalent as long as the specification for preferences involves the moving cost entering the utility function as a linear substitute for the consumption good.

3.3 Production Technology

Each country has a perfectly competitive representative firm that maximizes profits by choosing the amount of labor to hire while producing with the following constant returns to scale technology:

$$Y = ZNn$$

Where:

$Y\ is\ the\ output$

$Z\ is\ the\ total\ factor\ productivity$

$N\ is\ the\ number\ of\ workers$

$n\ is\ the\ labor\ supplied\ by\ each\ worker$

The firm's problem is trivial and its solution yields that the wage rate in a country is equal to the TFP of the country.

3.4 Moving Cost

All agents are identical except for their age, location and moving cost. Agents have an age-dependent fixed component in their moving cost - 'a' for young agents and 'a+b' for old agents. Every period, each agent realizes an idiosyncratic moving shock - a random term denoted by 'ξ' that adds to (or subtracts from) the age-dependent component of their moving cost. Based on their location and their realized total moving cost, the agents decide whether to migrate and suffer the moving cost or remain in their country of residence.

The total moving cost faced by an agent can be expressed as shown:

$$|l - l'| \cdot (a + b \cdot d + \xi)$$

Where:

$l'\ is\ choice\ of\ future\ location, l\ is\ current\ location$

$the\ term\ |l - l'| = 1\ if\ and\ only\ if\ the\ agent\ chooses\ to\ move\ (l' \neq l)$

$a\ is\ the\ fixed\ component\ of\ the\ moving\ cost\ applicable\ to\ young\ agents$

$b\ is\ the\ additional\ fixed\ component\ of\ the\ moving\ cost\ applicable\ to\ old\ agents$

$d\ is\ a\ dummy\ variable\ that\ equals\ 1\ for\ old\ agents$

$\xi\ is\ a\ shock\ to\ the\ moving\ cost, assumed\ to\ have\ a\ logistic\ distribution\ with\ mean\ 0\ and\ variance\ s$

The moving cost distribution can be explained thus: an agent's moving cost depends primarily on her age. The age-dependent component of the moving cost is fixed and identical for all agents of the same age. At the start of each period an agent realizes an idiosyncratic moving shock denoted by 'ξ'. A low 'ξ' could be associated with a willingness to migrate - possibly due to family or personal life events such as graduation etc. A very negative ‘ξ’ such that the total moving cost for an agent is also negative ($\xi < -a$ for young agents and $\xi < -(a+b)$ for old agents) can be explained as a desire to move to the other location - for some reason, the agent would rather stay in the other location than in her current location. As the model does not distinguish between return migrants and migrants (once an agent moves to a location, she is assumed to belong to her location of residence), the negative moving costs could also be agents desiring to return to their home locations. A logistic distribution is assumed for the moving shock as it approximates the normal distribution and at the same is analytical tractable and can be described sparsely with just two parameters.

It can be shown that having costs of the specified form in the utility function is equivalent to having the costs in the resource constraint.

3.4.1 Equivalence between Moving Cost in Preferences and Moving Cost in Budget Constraint

Consider a static one-period problem faced by a young agent

$$\max_{G,l',n} U\left(G - \left|l - l'\right| \cdot (a + \xi), n\right)$$

$$s.t.\ \ G = w_1 \cdot (1 - l') \cdot n + w_2 \cdot l' \cdot n$$

Where

G is the consumption good

l' is choice of future location, l is current location

$l = 0$ for country 1 and $l = 1$ for country 2

the term $|l - l'| = 1$ if and only if the agent chooses to move

a is the fixed component of the moving cost applicable to young agents

ξ is the shock to the moving cost

n is labor supply

w_1 is the wage rate in country 1 and w_2 is the wage rate in country 2

$$\text{Let } C = G - |l - l'| \cdot (a + \xi) \Rightarrow G = C + |l - l'| \cdot (a + \xi)$$

Above problem can then be rewritten as follows:

$$\max_{C,l',n} U(C, n)$$

$$s.t.\ \ C + |l - l'| \cdot (a + \xi) = w_1 \cdot (1 - l') \cdot n + w_2 \cdot l' \cdot n$$

$$\text{or } s.t.\ \ C = w_1 \cdot (1 - l') \cdot n + w_2 \cdot l' \cdot n - |l - l'| \cdot (a + \xi)$$

The former specification includes the moving cost in preferences, while the latter equivalent specification has the moving cost in the resource constraint. It should be noted that the value of consumption in the latter case includes the factor for the moving cost. Also, for both these problems, it is assumed that the agent solves for G, l and n or

C, l and n simultaneously because the choice of location will have an impact on the choice of G or C and n. Essentially, the agent solves for what she would have consumed (G or C) and what would have been her labor supply (n) for each possible country of choice and then picks the country and the corresponding G (or C) and n based on the option that results in greater utility. In the above format, the discrete choice nature of the problem may not be immediately apparent as all the optimizations are embedded within the same maximization problem.

While solving the above model, for ease of computation, it will be assumed that the moving cost is in the resource constraint while keeping in mind that if the definition of consumption is suitably modified to include moving costs, the results will also hold for moving costs of the specified form in the utility function.

3.5 Timing

The sequence of events is as shown on the time line in Figure 11. It should be noted here that agents can make the migration decision in the same period that they realize their TFP and moving shock. Hence, each period, agents can migrate between the two countries to exploit the TFP differential. In quarterly models, often a lag is assumed - i.e. capital or labor cannot be relocated until the next period. In an annual model, this seems less reasonable - migrants can and do respond contemporaneously to differences in TFP as can be seen from the evidence presented in the Data section.

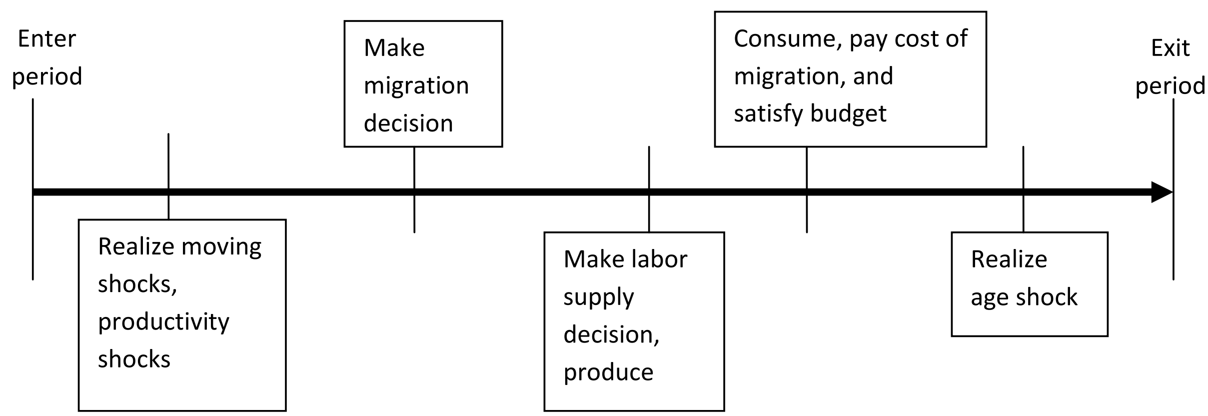


Figure 11

3.6 Planner's Dynamic Programming Problem

Assuming complete markets, perfect insurance, perfect information and no externalities, the decentralized problem can be rewritten as a planner's problem. Essentially, each agent is able to eliminate the idiosyncratic risks associated with aging, moving shocks and the insurable portion of the aggregate TFP. The only source of uncertainty after insurance is the aggregate shock. With complete markets the only difference between agents will be their location, age and moving shock. Thus in each country, there will be a cutoff for young agents and another cutoff for old agents such that agents with a moving shock below their respective cutoffs will migrate to the other country. In the planner's problem too, the benevolent social planner can assign the same cutoffs and move the agents with lower moving costs as well as decide leisure and consumption of all agents.

The planner’s state variables are $\boldsymbol{Z}$ (vector of TFPs), **L** (vector indicating the number of young agents in country one and country 2) and **H** (vector indicating the number of old agents in country 1 and country 2). The planner’s decision variables are the four cutoffs for migration (as there is also reverse migration each period) and the consumption and labor allocations to agents in each country. The planner weights each agent identically. Also, the consumption and labor decision of each agent within a country is the same (planner does not discriminate between them, or more intuitively, in the decentralized version, agents within a country are identical as they have insured away all the idiosyncratic shocks relating to age and moving costs). Output can be costlessly shipped from one location to another

The Planner’s Problem can be written as shown below:

$$V(\boldsymbol{Z},\boldsymbol{L},\boldsymbol{H}) = \max_{\xi^*_{1,L},\xi^*_{2,L},\xi^*_{1,H},\xi^*_{2,H},C_1,C_2,n_1,n_2} N_1 \frac{\left(C_1 - \frac{n_1^{\omega}}{\omega}\right)^{1-\gamma} - 1}{1-\gamma}$$

$$+ N_2 \frac{\left(C_2 - \frac{n_2^{\omega}}{\omega}\right)^{1-\gamma} - 1}{1-\gamma} + \beta\, E_{\boldsymbol{Z}'}\; V(\boldsymbol{Z}',\boldsymbol{L}',\boldsymbol{H}')$$

$$s.t. \quad N_1C_1 + N_2C_2$$

$$= Z_1N_1n_1 + Z_2N_2n_2 - \Big[L_1 \int_{-\propto}^{\xi^*_{1,L}} (a+x)\cdot f(x)dx + L_2 \int_{-\propto}^{\xi^*_{2,L}} (a+x)\cdot$$

$$f(x)dx + H_1 \int_{-\propto}^{\xi^*_{1,H}} (a+b+x)\cdot f(x)dx + H_2 \int_{-\propto}^{\xi^*_{2,H}} (a+b+x)\cdot f(x)dx\Big]$$

$$and \quad N_i = L_i^{'} + H_i^{'} \quad \forall\, i = 1,2$$

Where

$\xi^*_{i,j}$ is the cutoff moving shock for agents in country i and of type j – agents below this level of moving shock will migrate to the other country in the same period

C_i is the consumption of an agent in country i after migration has taken place

n_i is the labor supplied by an agent in country i after migration has taken place

N_i is the total number of agents in country i after migration and age change has taken place, that is, $N_i = L'_i + H'_i$

The first two terms in the resource constraints are the aggregate consumptions in country 1 and 2 respectively. The next two terms are the aggregate productions in the two countries respectively. Finally, the term in the square brackets is the aggregate moving cost. In the expression for the moving cost, f(x) is the probability density function of the logistic distribution and a+x is the cost paid by a young mover who has realized a shock of x while a+b+x is the corresponding cost for an old mover. Everyone with a moving shock less than their respective cutoff ξ* (based on age and location) is made to move and there are L_1 young movers in country 1 (and so on…). So the total resource cost of moving can be obtained by integrating over the cost suffered by movers of both types in both countries.

The evolution of the age distributions is given by:

$$L'_1 = \alpha\left[L_1 - L_1 \cdot F\left(\xi^*_{1,L}\right) + L_2 \cdot F\left(\xi^*_{2,L}\right)\right] + (1-\pi)\left[H_1 - H_1 \cdot F\left(\xi^*_{1,H}\right) + H_2 \cdot F\left(\xi^*_{2,H}\right)\right]$$

$$L'_2 = \alpha\left[L_2 - L_2 \cdot F\left(\xi^*_{2,L}\right) + L_1 \cdot F\left(\xi^*_{1,L}\right)\right] + (1-\pi)\left[H_2 - H_2 \cdot F\left(\xi^*_{2,H}\right) + H_1 \cdot F\left(\xi^*_{1,H}\right)\right]$$

$$H'_1 = (1-\alpha)\left[L_1 - L_1 \cdot F\left(\xi^*_{1,L}\right) + L_2 \cdot F\left(\xi^*_{2,L}\right)\right] + \pi\left[H_1 - H_1 \cdot F\left(\xi^*_{1,H}\right) + H_2 \cdot F\left(\xi^*_{2,H}\right)\right]$$

$$H'_2 = (1-\alpha)\left[L_2 - L_2 \cdot F\left(\xi^*_{2,L}\right) + L_1 \cdot F\left(\xi^*_{1,L}\right)\right] + \pi\left[H_2 - H_2 \cdot F\left(\xi^*_{2,H}\right) + H_1 \cdot F\left(\xi^*_{1,H}\right)\right]$$

Where F is the cumulative density function of the logistic distribution and L_i and H_i are the number of young and old people in country i respectively.

At the start of each period, country 1 has L_1 young people. Once migration occurs, the number of young people decreases by the number of emigrants and increases by the number of immigrants. The number of young emigrants is [$L_1 \cdot F(\xi^*_{1,L})$] as everyone with a migration cost less than the cutoff, given age and location, emigrate. Similarly, the number of young immigrants is [$L_2 \cdot F(\xi^*_{2,L})$]. Thus, after migration and before aging, the number of young people in country 1 is given by $\left[L_1 - L_1 \cdot F\left(\xi^*_{1,L}\right) + L_2 \cdot F\left(\xi^*_{2,L}\right)\right]$. Similarly, the number of old people in country 1 after migration and before aging is $\left[H_1 - H_1 \cdot F\left(\xi^*_{1,H}\right) + H_2 \cdot F\left(\xi^*_{2,H}\right)\right]$. Upon the realization of the aging shock, α fraction of the young people stays young while a 1-π fraction of the old people are replaced by young agents. Thus the number of young people in country 1 at the start of the next period is given by

$$L'_1 = \alpha\left[L_1 - L_1 \cdot F\left(\xi^*_{1,L}\right) + L_2 \cdot F\left(\xi^*_{2,L}\right)\right] + (1-\pi)\left[H_1 - H_1 \cdot F\left(\xi^*_{1,H}\right) + H_2 \cdot F\left(\xi^*_{2,H}\right)\right].$$

The equations for the remaining age distribution terms are obtained similarly.

Also, the age distribution and population size are assumed to be invariant while solving the dynamic problem:

$L_1 + L_2 = L'_1 + L'_2 = L$ (the number of people who are young in the total population)

$H_1 + H_2 = H'_1 + H'_2 = L$ (the number of people who are old in the total population)

Figure 12 shows the time invariant logistic distribution of moving shocks as seen by the planner. The cost of moving every young agent below a certain cut-off (for instance, -2 as in Figure 12) is given by the equation below assuming that the population of young agents is 1. For any other population size, the cost would be multiplied by the size.

$$\textit{The cost of moving everyone with moving shock below } \xi^* = -2 \textit{ is } \int_{-\infty}^{-2} (a + \xi) * f(\xi)\, d\xi$$

$This\ is\ also\ the\ lowest\ cost\ with\ which\ fraction\ F(-2)\ of\ the\ population\ can\ be\ moved$

$where\ 'a'is\ \ themoving\ cost,\ \ f(.)is\ the\ logistic\ pdf\ and\ F(.)\ is\ the\ logistic\ cdf.$

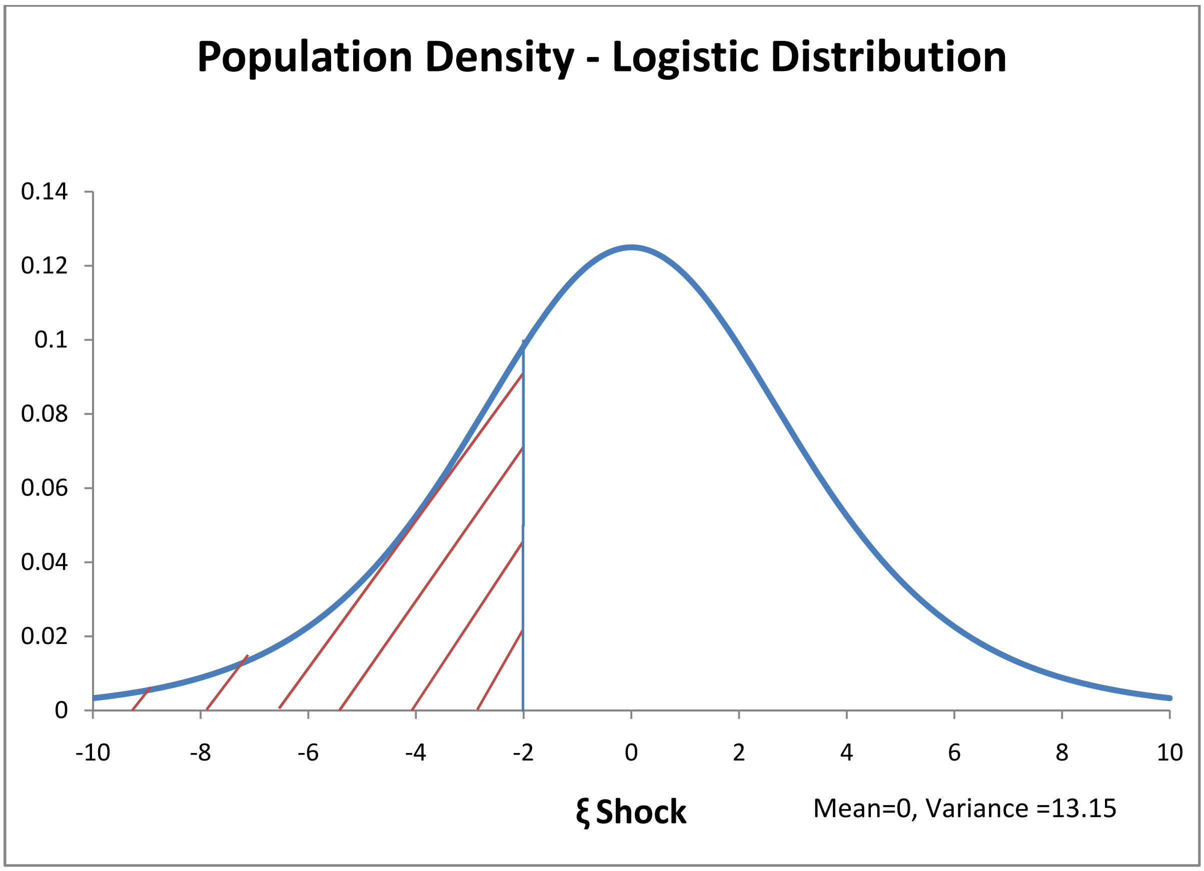


Figure 12

Figure 13 shows the cost of moving as the fraction of people moved increases, assuming a total population of 1. As can be seen, if no one moves the aggregate moving cost is 0. However, as the planner starts moving agents with negative moving costs (since their moving shocks are very negative, i.e. $\xi < -a$) the aggregate moving cost is also negative. The aggregate moving cost continues to fall as long as the agents who are being moved have negative total moving costs. However, as the fraction of population migrating increases, now agents with positive moving costs also have to move. This begins to increase the moving cost until the moving cost soon becomes positive. Finally, as all agents are moved, the aggregate moving cost approaches the no-shock moving cost since the mean of $\xi = 0$. A very high value of variance was used to construct Figures 12 and 13 to clearly illustrate negative aggregate moving costs - a feature essential to explain a prominent aspect of the data - reverse migration.

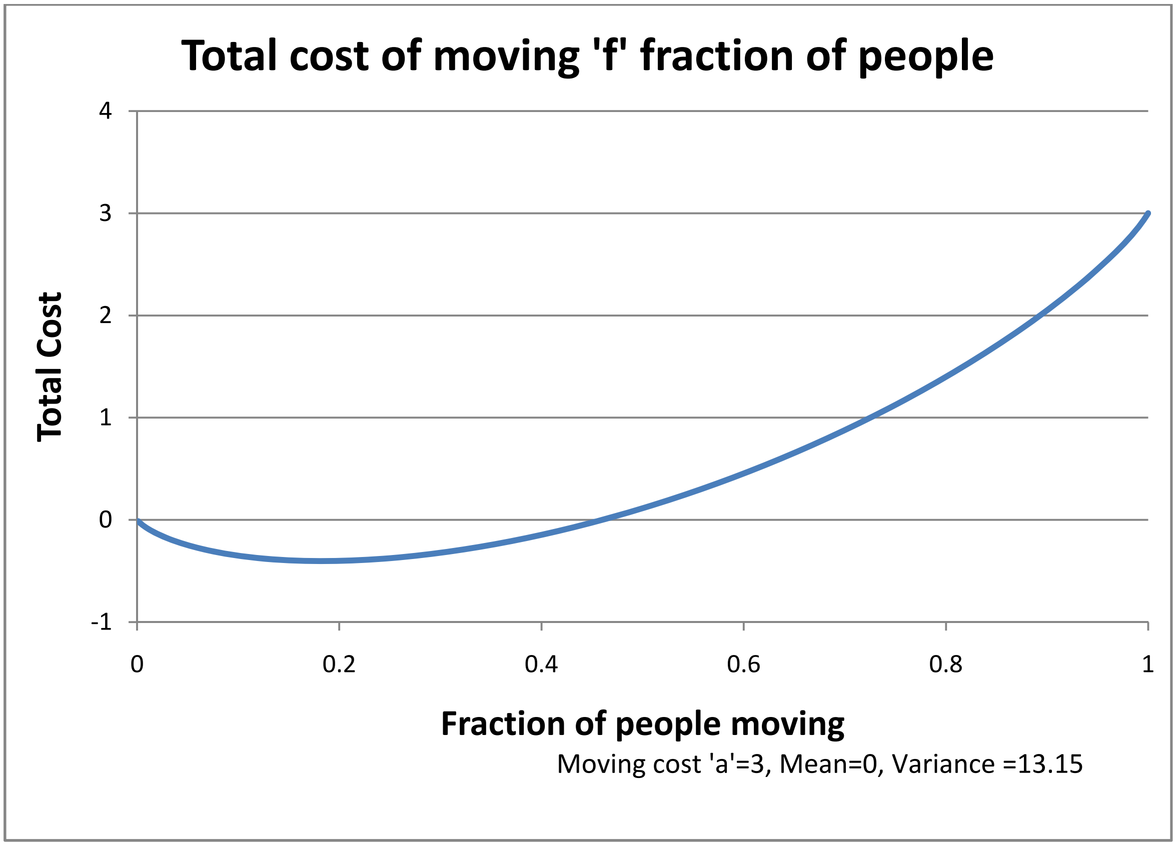


Figure 13

In fact, Figure 14 illustrates a simple static example of migration. Assuming that the home country has a TFP of 1, it shows who migrates and who doesn't for a range of foreign country TFPs and total moving costs for an agent. When home TFP is equal to foreign TFP, an agent with zero **total** moving costs is indifferent between moving and staying. So, all agents with costs higher than 0 do not move while all agents with costs lower than zero do move. However, as the TFP in the foreign country rises, agents with positive total moving costs also migrate. The figure also shows reverse migration.

Agents with sufficiently negative moving costs will migrate to the other country even when the TFP in the other country is the same or lower.

From Figure 14, it can be seen that this model can address the main features of the data - migration correlated to GDP while there are also reverse migrants each period. Also, a moving cost higher for international migration than for inter-region migration would explain the lower fraction of international migrants as compared to inter-regional migrants.

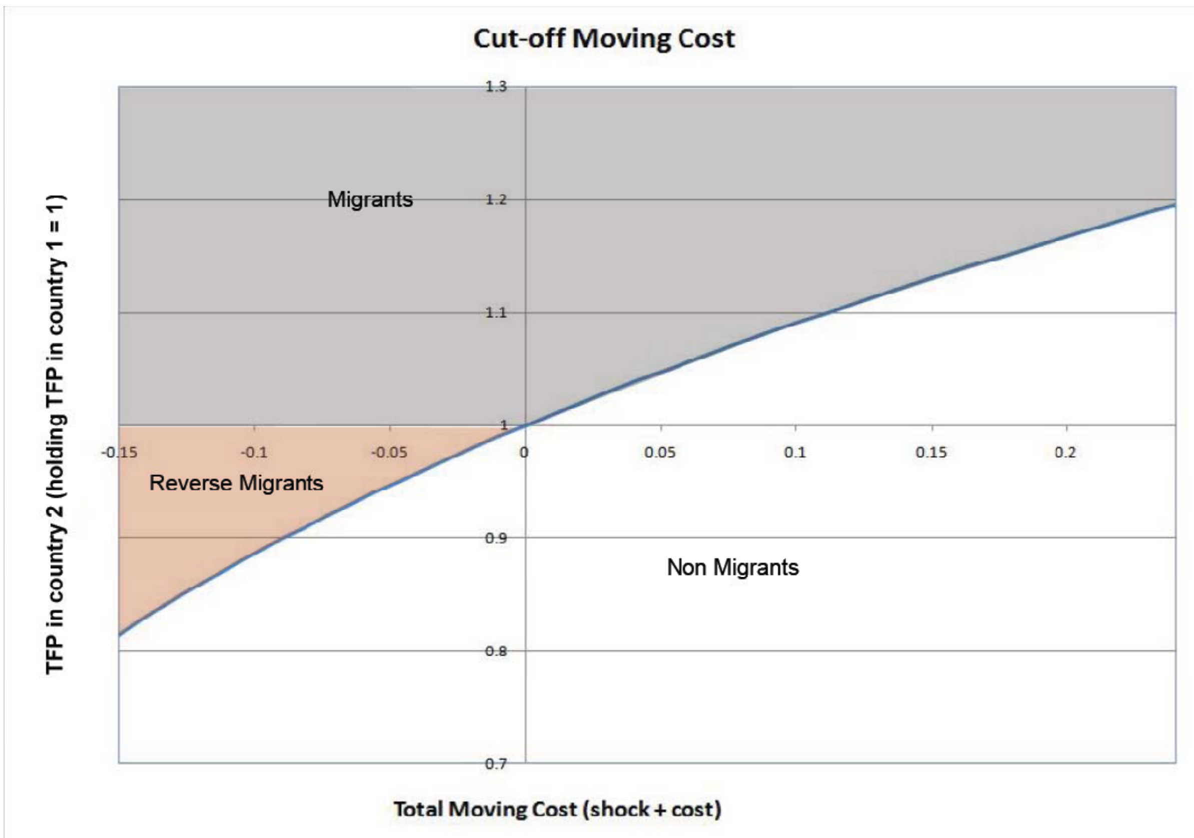


Figure 14

4 Calibration and Solution Techniques

Three commonly used parameters needed for this model are β (the discount rate), ω (1+the inverse of the inter-temporal elasticity of labor substitution) and γ (the coefficient of relative risk aversion). For these parameters I use standard RBC values such as those used Schmitt-Grohe and Uribe (2003). These values have been tabulated below.

Standard Parameters used for Calibration	
ω (1 + inverse of the inter-temporal elasticity of substitution in labor supply)	**1.455**
γ (the coefficient of relative risk aversion)	**2**
β (the annual discount rate)	**0.96**

Table 4

The parameters relating to the TFP process were estimated directly from the data. Using the production equation in the model and estimates of labor supply within Denmark and across Denmark and Sweden, TFPs were backed out and regressed to get estimates of the required parameters. The TFPs obtained are approximate as capital was not included while obtaining estimates. However, this was not deemed to be much of a concern as capital does not usually vary much cyclically. The spillover of the TFP process was not significantly different from zero for either case, hence it was assumed to be 0. The persistence parameter on the other hand was significantly positive and with a smaller standard error. Hence 'p' the persistence parameter was estimated directly. Similarly the correlation and variance of technology shocks were also estimated directly from the data using the error terms in the TFP regressions mentioned above. The correlation for East and West Denmark was high as was than the correlation for Denmark and Sweden indicating that the economies are closely tied. As can be expected, the correlation is higher for East and West Denmark. The estimate for the probability for staying young α and the probability for staying old π come directly from the assumption that the expected duration of youth is 20 years and the expected duration of old age is 30 years. These parameters are listed in Table 5.

Parameters estimated directly from data		
	Denmark-Sweden	East-West Denmark
p (persistence in VAR process for TFP)	**0.7259**	**0.7438**
ρ (x, y) (correlation of innovation shock)	**0.2642**	**0.2824**
σ (x, x) (variance of innovation shock)	**3.94e-04**	**1.47e-04**
α (probability of staying young)	**0.95**	**0.95**
π (probability of staying old)	**0.97**	**0.97**

Table 5

The remaining parameters of the model were estimated by matching moments using the Method of Simulated Moments within a value function iteration structure. In order to use the technique of dynamic programming, the TFP process had to be discretized. Unfortunately the analytical method suggested by Tauchen and Hussey (1991) for converting a VAR to a Markov process could not be used due to the significant cross correlation of the shocks or error terms in the VAR. A numerical method was used instead and data were simulated to compare results with the true VAR. The numerical method involved simulating data from the VAR and computing equal areas as with quadrature methods to find nodes and then computing transition probabilities from node to node. The process was repeated in a Monte Carlo setting numerous times until the standard errors of the estimates were small.

The remaining variables in the state space had to be discretized as well - the combined TFP process was discretized into 25 points while 35 points were chosen for each endogenous state variable resulting in a total grid size of 30625 points.

The data moments used for the simulated method of moments and the corresponding model moments are shown in Tables 6 and 7. As the model was over-identified, it could be tested for the identifying restrictions using the two-step method - by first estimating the optimal weighting matrix and then estimating the parameters again by matching moments. The fitness of the over-identification restrictions was rejected for both Denmark-Sweden and East-West Denmark as the J statistic was greater than the critical value of the chi square distribution for all levels of confidence.

Moments that were matched (Denmark – Sweden)		
	Data	Model
Number of total migrants as a percent of labor force	**0.031**	**0.032**
Fraction of migrants who are ‘Reverse Migrants’	**0.436**	**0.431**
Number of young migrants as a percent of labor force	**0.020**	**0.028**
Covariance of young migrants to old migrants	**0.001**	**0.001**

Table 6

Moments that were matched (East – West Denmark)		
	Data	Model
Number of total migrants as a percent of labor force	**0.584**	**0.586**
Fraction of migrants who are ‘Reverse Migrants’	**0.460**	**0.458**
Number of young migrants as a percent of labor force	**0.468**	**0.466**
Covariance of young migrants to old migrants	**0.273**	**0.274**

Table 7

The model was then estimated numerous times using a Monte Carlo approach and the resulting parameters and corresponding standard errors are reported in Table 8. While the implications of these numbers will be elaborated upon in the next section, it is interesting to note that the numbers for migration with Denmark and Sweden are similar to those obtained by Kennan and Walker (2006) in their US inter-state migration model (reported in Table 9).

Main Parameters Estimated		
	Denmark – Sweden	East – West Denmark
a (moving cost for young people)	**7.5256** (0.1335)	**3.9865** (0.0078)
b (additional moving cost for old people)	**3.4763** (0.0740)	**1.8090** (0.0128)
s (variance of moving shock)	**3.4824** (0.0894)	**0.466** (0.0106)

Standard errors are in parentheses

Table 8

Kennan and Walker Moving Costs (Two – Type Model)		
	Moving Cost (in terms of 2005 US dollars)	Moving Cost (in terms of per capita GDP)
Average Mover	**176,157**	**4.21**
Mover to Previous Location	**58,911**	**1.41**

Source: Kennan and Walker (2006) and author's calculations based on US per capita GDP in 2005

Table 9

The results in Kennan and Walker (2006) are similar to the costs of inter-regional migration within Denmark. Their models however include numerous factors such as distance of move and whether the migrant is a return migrant etc. Thus they obtain a range of moving costs – the results shown in the Table above are the ones they choose to present in their paper.

5 Results and Implications

The border effect is highlighted in Tables 10, 11 and 12. The numbers in Table 10 reflect the average over the entire population and include both, the *actual* moving cost for movers and the *potential* moving cost for non-movers. While the cost for internal migration in Denmark is similar to that for internal migration in the US as measured by Kennan and Walker (2006), international migration is much costlier. For both young and old agents, the mean moving cost for crossing a national border is almost twice as much as that for crossing a regional border. In terms of variance, there is a higher variance of the moving shock for international migrants.

Average Total Moving Costs for Agents includes **actual** costs borne by movers as well as **potential** costs faced by non-movers (in terms of annual per capita GDP)		
	Denmark-Sweden	East-West Denmark
a (moving cost for young people)	**7.5256**	**3.9865**
a + b (moving cost for old people)	**11.0019**	**5.7955**

Table 10

Table 11 compares average inter-regional and international moving costs actually paid by young and old agents who migrate despite facing a positive moving cost. Young agents who choose to move across national borders typically suffer twice the cost as compared to similar agents who choose to move across regional borders. For old agents, the difference is even greater – with international movers bearing about four times the cost paid by domestic movers. The numbers in Table 11 are much smaller than those in Table 10 because the former considers actual movers (typically, a very small fraction of the population) and the latter considers all agents – movers and non-movers. Those who do move have extremely low realizations of the moving shocks (ξ) compared to the average for the entire population.

Mean of Moving Costs **actually paid** by agents who migrate despite facing a positive moving cost (averaged over different realizations of TFP and in terms of annual per capita GDP)		
	Denmark-Sweden	East-West Denmark
moving cost for young people	**0.0320**	**0.0157**
moving cost for old people	**0.6251**	**0.1472**

Table 11

Another way to consider the impact of the border is to examine the cost faced by the marginal mover. Every period, only those with low total moving costs move. The marginal mover in any period can be described as the individual whose moving cost is such that he is exactly indifferent between moving and not moving. The marginal mover has a low total moving cost because he usually has a strongly negative moving shock ξ. In any given period, those with moving costs greater than the marginal mover for that period do not migrate. Thus the highest cost *actually* paid by a migrant in any period cannot exceed the cost faced by the marginal mover for that period. The results for the marginal mover indicate that averaged over different realizations of TFP, a young marginal mover pays a cost of only 3% of GDP per capita in order to move from one region to another and 6% of GDP per capita to move from one country to another. Similarly, averaged over different realizations of TFP, old marginal movers pay a cost of 1.2 times GDP per capita while moving across international borders and about 30% of GDP per capita while moving across regions in Denmark. It can be seen therefore that the marginal young migrant crossing a regional border faces less than half the cost when compared to the marginal young mover crossing a national border. For old marginal movers, the difference is even more marked - with those crossing national borders paying almost four times as much as those crossing regional borders.

Moving Cost faced by **marginal** mover who is indifferent between migrating and not migrating (averaged over different realizations of TFP and in terms of annual per capita GDP)		
	Denmark-Sweden	East-West Denmark
moving cost for young marginal mover	**0.0639**	**0.0314**
moving cost for old marginal mover	**1.1892**	**0.2903**

Table 12

These numbers indicate a clear and significant border effect in labor supply. Despite there being no policy restrictions on migration between Denmark and Sweden and despite the similarity of the two countries, Danish residents face a much higher cost for moving across national borders than they do for moving across regional borders.

While the characteristics of the cost associated with moving across borders are interesting in and of themselves, they also have far reaching economic implications. One interesting counterfactual experiment to understand the importance of the border effect is to analyze what would happen if the moving costs across the two countries were to be the same as inter-regional moving costs. For computing welfare, the magnitude of the planner's value function is compared across the two specifications. In the former specification, the international border has its true cost and in the latter, its cost is counterfactually assumed to be equal to that of regional borders. The welfare gain is obtained as the amount by which annual consumption would have to increase each period for the two value functions to be equal. Denmark and Sweden would enjoy a welfare gain of about **0.15%** if the national moving costs across the two countries were to mirror the moving costs across Danish regions. This number is significant from the standpoint of business cycle studies. For instance, when constant relative risk aversion is 2, the cost of business cycles using the framework in Lucas (1987) is 0.016% for the US. However, it should be noted that the high number in this paper could include both the psychic cost of moving and the resource cost of moving as the model does not explicitly distinguish between the two.

As Denmark and Sweden have actively implemented numerous policies to facilitate easy migration, it is doubtful whether this moving cost can be changed substantially with further policies. Moreover, despite their numerous differences Denmark and Sweden are quite similar in terms of language, culture, heritage etc. Hence this loss in welfare reflects a good estimate of the true cost of having a national border, isolated from other sources of migration costs such as policy restrictions and severe socio-cultural barriers.

In the literature, papers such as Klein and Ventura (2004, 2005), Moses and Letnes (2004), Walmsey and Winters (2003) and many others measure the importance of migration by estimating the potential welfare gain from the hypothetical opening of borders across countries where borders are currently closed in reality. The model and data of this paper on the other hand can be used to compute the importance of migration by using a converse approach. How much is the improvement in welfare due to the borders being open as they are in reality when compared to a hypothetical alternative scenario with closed borders?

Accordingly, in a second counterfactual experiment, welfare was analyzed for Denmark and Sweden assuming a closed border. Next, welfare was calculated again - now with the border open and true international moving costs. Finally welfare was calculated a third time - this time assuming open borders again but with moving costs across Denmark and Sweden assumed to be the same as for regions within Denmark. As can be seen in Table 13, the true welfare gains from open borders are 0.67%. If national border effects had been ignored, the welfare gains from open borders would have been computed as 0.82% thereby overestimating the benefits of open borders by about 18%. This suggests that models of potential migration across currently closed borders should seriously consider including border effects for labor supply or risk greatly overestimating the gains from open borders. Crossing a national border involves significantly higher costs than crossing a regional border, even when migration is perfectly legal and encouraged by policy.

Welfare Analysis	
Welfare gain due to open borders estimated while **including** the effect of national borders	**0.67%**
Welfare gain due to open borders estimated while **ignoring** the effect of national borders	**0.82%**
Overestimation of welfare if border effects are ignored	**18%**

Table 13

5.1 The Road Ahead and Future Work

One natural and straightforward extension of this paper would be to use the model presented here to simulate data and compare directly to micro data and models. Another would be to consider a three-region model to include considerations of inter-region and international labor migration within the same setup. A third addition could be to apply the estimates from the model for numerous bordering countries that do not allow international migration. Thus by considering their joint TFP processes and potential migrations predicted with this model, good estimates of aggregate welfare gains from opening up borders can be obtained.

The method used to analyze the cost of border in terms of labor mobility can also be extended easily to include other Nordic countries right away as well as various EU countries once more data becomes available for them. Using such an approach, the effect of other national characteristics on migration costs can be estimated as well. For instance, Finland is part of the common Nordic Labor Market but Finnish is a very different language from Danish, Swedish and Norwegian. Studying the same question while looking at Finland as well as Denmark, Sweden and Norway can shed some light on the impact of language on migration costs. A common cost of migration present in other models that has been omitted in this paper (largely because that cost is theoretically similar whether the migration is across regions or nations) is the impact of a fixed factor of production such as land. If land is included explicitly in the model, better estimates of the consequences of neglecting the effect of national borders can be obtained and these estimates can be applied directly to numerous papers that include land in their analysis while dealing with international migration such as Klein and Ventura (2006).

The Macroeconomic Impact of Migrant Remittances in an Overlapping-Generations Model

This chapter studies the impact of migrant remittances on welfare, consumption, savings and the structure of production between traded and non-traded sectors in both the remittance sending and the remittance receiving countries. Micro foundations are used to model remittances explicitly in an overlapping-generations framework where remittances are driven entirely by the savings decisions of migrants who return to their home country upon retirement. Data from South Africa and Lesotho are used to calibrate the model. The results show that remittances are influenced by the economic prospects in the host country. Restricting migration reduces both home country and aggregate welfare although remittances have an impact on the real exchange rate and the structure of production in the recipient country in accordance with the phenomenon known as 'Dutch Disease.' A counterfactual exercise using the model solution demonstrates that citizens of the host country would suffer a welfare loss of 1.2% if it were to choose assisting the recipient country with foreign aid instead of allowing migration.

1 Introduction

The magnitude of migrant remittances has increased tremendously in recent years. According to World Bank estimates, developing countries received 240 Billion

US Dollars worth of remittances from migrants in 2007[2]. Thus, remittances have become an increasingly important area of research in recent years.

Empirical literature on remittances suggests that their volume is influenced by aggregate variables in both, sending and receiving countries. Papers that study recipient country effects include Chami et al (2003) who find remittances to be countercyclical, and Giuliano and Ruiz-Aranz (2006) who find them to be procyclical. Vargas-Silva and Huang (2005) study both host (sending) and home (receiving) country effects and they conclude that remittances depend more strongly on the sending country's aggregate variables.

At the same time, due to their large magnitude, remittances also have significant consequences for recipient economies. Many papers in the literature study the impact of migrant remittances on various relevant macroeconomic variables such as welfare, the structure of production and the real exchange rate. One issue that has received considerable attention is the role played by remittances in causing a phenomenon known as 'Dutch Disease.' In the words of Acosta et al (2007):

> *The term 'Dutch Disease' was originally used to describe the difficulties faced by manufacturing in the Netherlands following the development of natural gas on a large scale which triggered a major appreciation of the real exchange rate. It has since been used to refer to any situation in*

[2] Source: World Bank: http://go.worldbank.org/QOWEWD6TA0 (World Bank, 2008)

which a natural resource boom, or large foreign aid, or capital inflows, cause real appreciation and jeopardizes the prospects of the tradable sector.

Therefore, a model with two sectors (traded and non-traded goods) is required in order to study the macroeconomic impact of remittances while allowing for Dutch Disease effects. Moreover, since both host and home country macroeconomic variables are empirically seen to be relevant, the model should also feature both countries. Although various motives for remittances have been proposed and studied, this chapter assumes that all remittances are driven by the savings motive of migrants who relocate to their home country upon retirement (an alternative framework involving familial altruism is considered in the next chapter). Thus, the model also needs at least two generations, one working and the other retired. All these features are included in a parsimonious, deterministic, general equilibrium overlapping-generations model involving two countries (home or remittance receiving country and host or remittance sending country), two sectors (traded and non-traded) and agents who live for two periods (working and retirement) each.

South Africa and Lesotho were chosen for this study because sector level GDP and remittance data are readily available for the pair and almost all of the remittances

(84%, according to World Bank sources[3]) into Lesotho come from South Africa. Thus, ignoring the presence of other countries in the model should not affect the findings significantly.

The model is parameterized using various features of the data. The model's solution suggests that remittances are welfare enhancing despite their adverse impact on the real exchange rate and their contribution to the phenomenon of Dutch Disease. Aggregate welfare decreases when migration is decreased because restricting migration greatly reduces home country welfare even though they marginally improve host country welfare. The host country gains higher welfare by allowing migration from the home country rather than providing it equivalent foreign aid.

1.1 Related Literature

For detailed surveys of the literature please refer to Page and Plaza (2006), Rapoport and Docquier (2005) and Loser et al (2006). Although most papers on remittances have a microeconomic focus, there are some informative papers that adopt a macroeconomic perspective. Giuliano and Ruiz-Aranz (2006) conduct an empirical study and find that remittances lead to growth. Other empirical papers include Bourdet and Flack (2006) as well as Amuedo-Dorantes and Pozo (2004), both of which show that remittances cause Dutch Disease. McComick and Wahba (2000) is a theoretical paper that studies a model involving two countries, two sectors and two skill levels of labor

[3] Source: World Bank: http://go.worldbank.org/ U4RXL56V20 (World Bank, 2008)

supply to study the causes and consequences of migration and remittances. Papers that solve macroeconomic models and are closely related to this chapter include Chami et al (2006) and Acosta et al (2007).

Chami et al (2006) do not consider Dutch Disease effects while Acosta et al (2007) focus primarily on this issue. However, both these papers ignore the role played by the macroeconomic variables of the remittance sending country. Rather than model remittance decisions explicitly, they assume an exogenous process for remittances. In the former paper, remittances are assumed to be countercyclical, while the latter considers acyclical, procyclical and countercyclical remittances in three separate scenarios. This paper adds to the current literature on the macroeconomics of remittances by solving a structural model that includes host and home country effects explicitly and treats remittances as an endogenous variable determined through micro foundations. The next section examines the data, section three presents the model and section four provides details regarding the calibration. The results and implications of the model are discussed in the fifth section which is followed by a brief exploration of possible future work.

2 Examining the Data

The data used for this exercise are from Lesotho and South Africa. Although Lesotho is much less developed than South Africa, both economies can be considered to belong to the 'Global South' and according to Ratha and Shaw (2007), South-South remittances are very important economically (amounting to almost 20% of all inward remittances to developing countries) warranting the need for detailed studies in the area. This is particularly true for Lesotho which receives annual remittances that amount to almost 25% of its total GDP. Moreover, in the context of the model being considered these two economies form a good country pair as almost all (84%)[4] of Lesotho's inward remittances come from South Africa. At the same time, a significant fraction (70%)[5] of South Africa’s outward remittances goes to Lesotho. Thus ignoring the influence of other countries can be somewhat justified for a model of remittances between South Africa and Lesotho, especially from the perspective of Lesotho (the 'home economy' and the country of focus in this paper).

Lesotho is a small, landlocked, mountainous country surrounded on all sides by South Africa.

[4] Source: World Bank: http://go.worldbank.org/ U4RXL56V20 (World Bank, 2008)
[5] *ibid*

Figure 15

A significant fraction (20% of the labor force)[6] of working age Basotho find employment in South Africa. Mining is the predominant occupation (68%) of these Basotho migrants according to UN-INSTRAW and SAIIA (2007). Further, in Migration Policy Series (#2, 1997) of the South Africa Migration Project, Sechaba Consultants report that more than 70% of Basotho miners prefer to return to Lesotho rather than stay on in South Africa after the duration of their employment. These facts support the proposed two-country overlapping-generations model where migrants return to their home country upon retirement.

As can be seen from Figure 2, data from the national accounts of Lesotho and South Africa suggest that to a significant extent, the two economies share the same

[6] Source: Global Policy Network: http://www.gpn.org/ (Global Policy Network, 2006)

business cycle. Remittances to Lesotho too are positively and strongly correlated to this cycle. This could be considered as supporting the findings of Vargas-Silva and Huang (2005) who report that remittances depend more strongly on the sending countries economic circumstances. Alternatively, the figure could be used to support the hypothesis that remittances are procyclical with the recipient country's economy because they are driven by investment motives rather than altruistic motives.

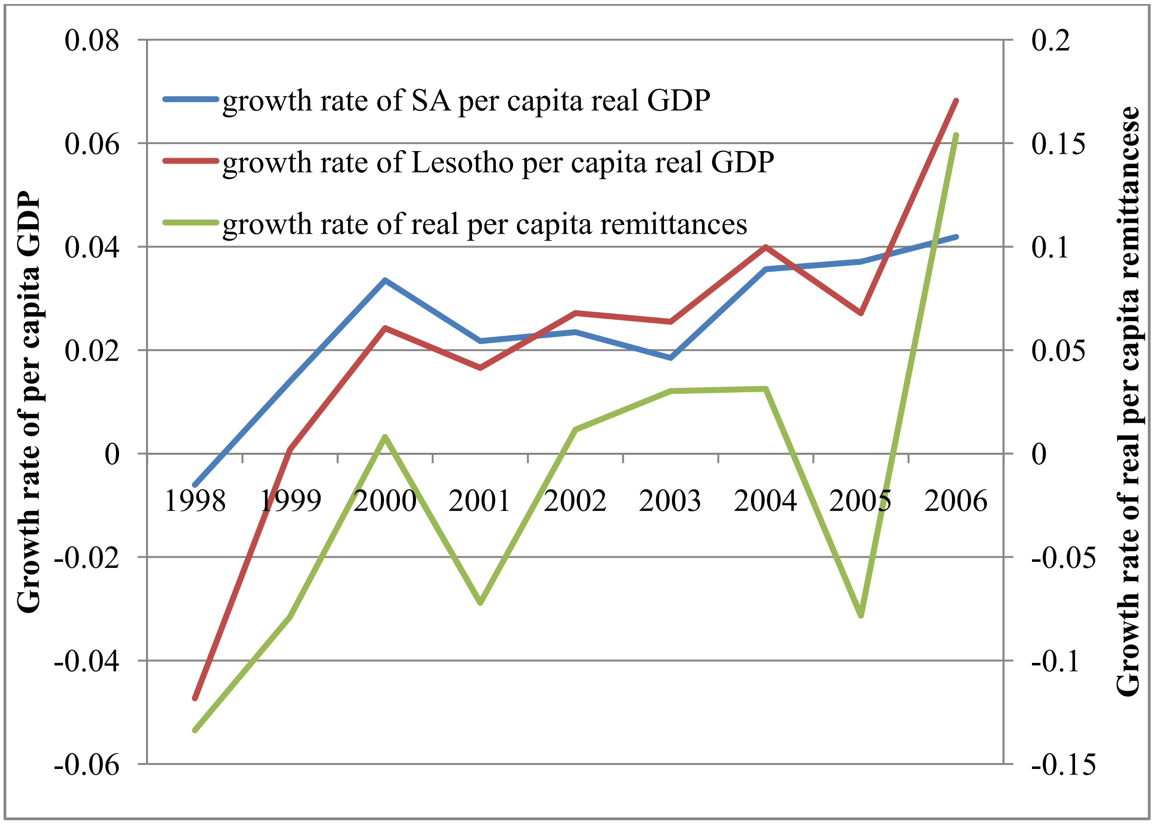


Figure 16

Since Lesotho and South Africa appear to be on almost the same business cycle, it is hard to disentangle the two possibilities by looking cursorily at the data. The correlations reported in Table 1 verify these co-movements. The growth rate of remittances is positively and significantly correlated with the per capita real GDP growth of both Lesotho and South Africa. Although the value of this correlation is higher for Lesotho, the two correlation statistics are not significantly different from each other.

Selected Correlations from the Data	
Growth rate of South Africa per capita real GDP - Growth rate of Lesotho per capita real GDP	0.92*
Growth rate of Lesotho per capita real GDP - Growth rate of real per capita remittances	0.86*
Growth rate of South Africa per capita real GDP - Growth rate of real per capita remittances	0.69*
Growth rate of real exchange rate - Growth rate of real per capita remittances	0.74
Growth rate of real per capita non-traded output - Growth rate of real per capita remittances	0.70*
Growth rate of real per capita traded output - Growth rate of real per capita remittances	0.73*
* significant at 95% level	

Table 1

The data can also be analyzed to find whether remittances cause Dutch Disease in Lesotho. In terms of exchange rates, the data is unambiguous. As can be seen in Figure 3 and Table 1, the growth rate of remittances is correlated with the growth rate of the real exchange rate (the correlation is not significant even at the 90% level probably due to the short length of the series for the real exchange rate). In this paper, real exchange rate is defined as the price of one unit of the composite South African good in terms of the composite Lesotho good. Thus, according to Figure 3, as remittances increase, it takes a greater number of composite Lesotho goods to buy 1 composite South African good lending support to a positive diagnosis for Dutch Disease.

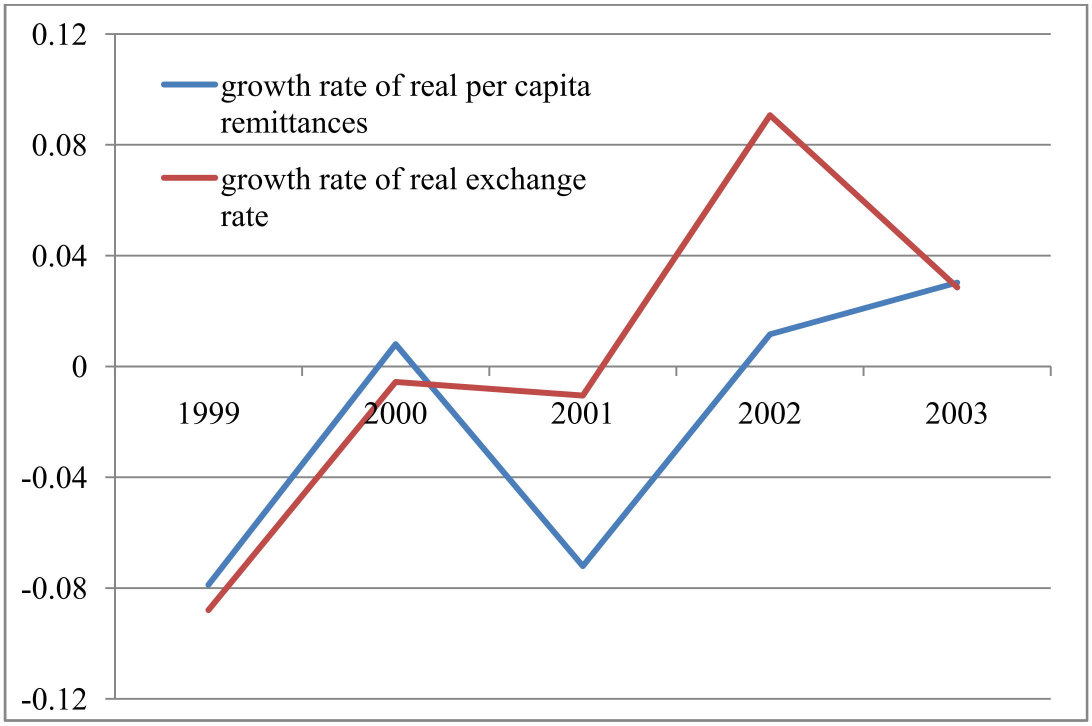


Figure 17

Another way to test for the presence of Dutch Disease is by studying the correlation between the non-traded goods sector and remittances. Figure 4 suggests that as remittances increase, so does the output of the non-traded goods sector, suggesting the presence of Dutch Disease. This can also be seen from the high correlation between the growth rate of real per capita non-traded output and the growth rate of real per capita remittances in Table 1. However, at the same time, it can be seen that remittances are also strongly correlated to the traded goods sector. Once again, while both correlations are positive and significant individually, the two statistics are not significantly different from each other. Therefore, these sectoral analyses fail to provide any conclusive evidence regarding Dutch Disease.

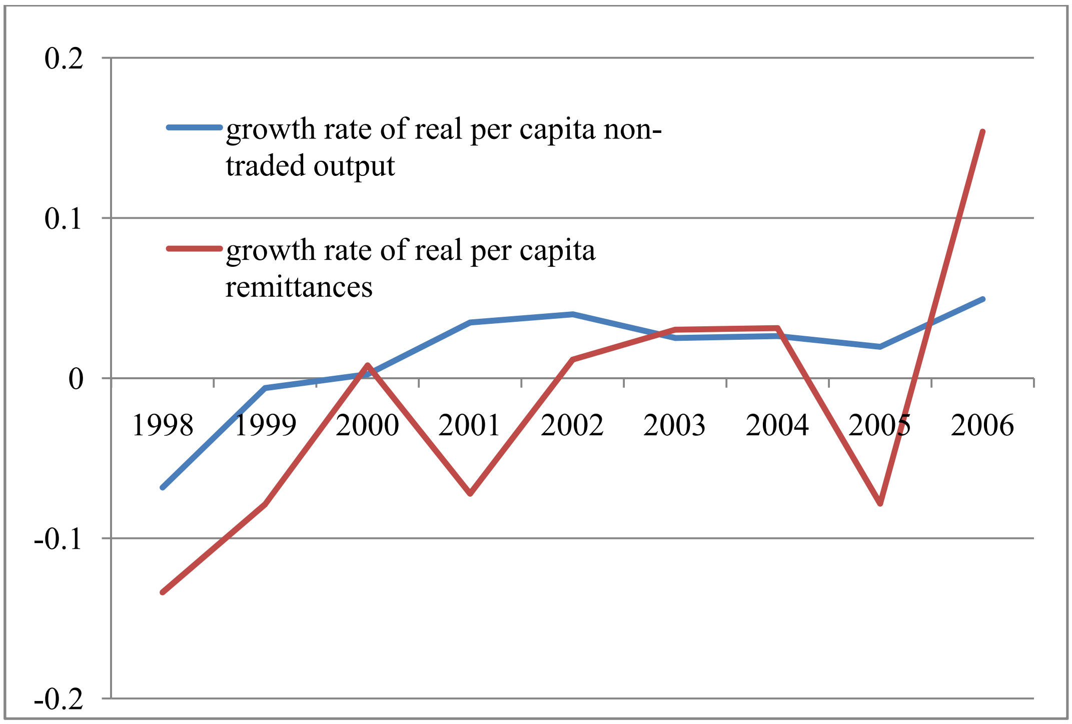


Figure 18

In order to obtain a better understanding of remittances, a structural model is set up and solved in the following sections.

3 Model

The data are analyzed using a two-country, two-sector, general equilibrium, overlapping-generations model with agents who live for two periods (youth and retirement). A constant fraction of the home country population spends their youth as migrants in the foreign country. Remittances in this model take the form of the savings made by these young migrants who relocate to their home country upon retiring. Two countries are considered in order to capture home and host country effects in explicitly modeled remittance decisions. Two sectors are also necessary in order to study the issue of Dutch Disease. The model abstracts away from capital accumulation decisions and young agents can save for retirement only by purchasing land (a productive asset that yields rent) in their home country using traded goods (the only commodity in the economy that can cross borders). This is broadly consistent with the idea that ultimately all foreign aid, remittances and other international transfers involve the flow of tradable goods since non-traded goods cannot cross borders. Another important aspect of this model is that the resources in both economies stay fixed as capital accumulation is ignored. Host country residents are therefore unable to adjust to increases in migration by increasing their level of capital. Hence this model solution suggests an upper bound for the welfare loss experienced by the host country due to migration. This feature of the model is useful for some of the welfare studies performed later in the paper. Moreover the presence of an immobile factor of production for tradable goods guarantees that both countries manufacture both kinds of goods.

One of the major limitations of this model is that agents live only for two periods. Although two periods can adequately describe the work-retirement effects the model seeks to capture, more periods could have mirrored actual demographic details better. However, increasing the number of periods in the life of each agent caused computational difficulties, probably due to the presence of multiple equilibria in multi-sector OLG models. For a detailed discussion of this issue, please refer to Galor (1992). With two-period lived agents however no problems were encountered during computation. In fact, even a dynamic, stochastic version of the two-period model was solved. But this model was difficult to calibrate as each period in an agent's life is equivalent to half an adult life time and the span of available time series data (10 years for most variables and even less for others) was inadequate for the exercise. Thus, a steady state version of the model was solved and calibrated in terms of key ratios available in data that are independent of the frequency of sampling.

3.1 Agents

All agents in the model live for two periods each. At any given time there are two generations:

- The working generation - each member of this generation is endowed with one unit of labor which is supplied inelastically to firms in order to earn wages. These wages are used to finance consumption (of both traded and non-traded goods) and savings for retirement through the purchase of land.
- The retired generation - members of this generation are not endowed with labor. They rent out the land they purchased during youth to firms for production. Finally they sell their land holdings and use the revenue from the sales as well as their rental income in order to consume traded and non-traded goods.

Both generations have the same size which stays fixed over time. In other words, each period a new generation enters the workforce which replaces the identically sized generation that retires from the workforce which in turn is of the same size as the previous retired generation that has now died.

Also, this model features three kinds of agents - home agents, migrant agents and foreign agents.

- Home agents – These agents live for both periods in the home country. They can buy and sell land only in their home country.
- Foreign agents – These agents live for both periods in the foreign country (which is home for them). Foreign agents can buy and sell land only in the foreign country.
- Migrant agents – These agents live in the foreign country in the first period but relocate to their home country for retirement. Migrant agents can only buy and sell land in their home country even though they live, work and consume goods in the foreign country during their youth.

Again, the population size of both the home country and foreign country stays fixed and the fraction of the home country young employed abroad stays fixed over time. In the model, populations are normalized in terms of the number of home country citizens (citizens include home agents and migrants), which is given a value of 2.

The demographic structure can be described thus:

Total population of home country citizens = 2

Fraction of young home country citizens that are migrants = α

Total population of home country citizens = 2 x F

To see the demographics in terms of residents, please refer to Tables 2 and 3.

Home Residents	
Young home agents	$1 - \alpha$
Total young agents at home	$\mathbf{1 - \alpha}$
Old home agents	$1 - \alpha$
Old migrant agents who have returned home	α
Total old agents at home	**1**
Total population at home	$\mathbf{2 - \alpha}$

Table 2

Foreign Residents	
Young foreign agents	F
Young migrant agents	α
Total young agents abroad	$\mathbf{F + \alpha}$
Total old agents abroad	**F**
Total population abroad	$\mathbf{2 F + \alpha}$

Table 3

3.2 Preferences and Budget Constraints

Preferences are time separable with an appropriate discount rate for future utility during retirement. Agents derive utility by consuming a composite consumption good that aggregates tradable and non-tradable goods. The consumption aggregator is of CES (constant elasticity of substitution) form with unit elasticity of substitution. This utility function is adopted as it is computationally and analytically tractable and is very common in the literature. In particular this is the functional form used by Acosta et al (2007). Agents receive no disutility from working and hence do not face a labor-leisure decision. In log terms, the utility function of an agent who is young in period t can be expressed thus:

$$U = \gamma \log C_{T,t}^{Y} + (1-\gamma) \log C_{NT,t}^{Y} + \beta\left[\gamma \log C_{T,t+1}^{O} + (1-\gamma) \log C_{NT,t+1}^{O}\right]$$

Where:

γ is the share of tradable goods in total consumption

$C_{T,t}^{Y}$ is the quantity of tradable goods consumed in period t by the young agent

$C_{NT,t}^{Y}$ is the quantity of non-tradable goods consumed in period t by the young agent

$C_{T,t+1}^{O}$ is the quantity of tradable goods consumed in period t+1 by the old agent

$C_{NT,t+1}^{O}$ is the quantity of non-tradable goods consumed in period t+1 by the old agent

β is the discount rate

Income and substitution effects perfectly cancel each other with log utility specifications and this helps capture the findings of Vargas-Silva and Huang (2005) who emphasize that host country conditions largely determine the volume of remittances.

Agents face a budget constraint in each period of their lives. While young they earn wage income which they can spend on traded goods, non-traded goods and savings in the form of land holdings. When old, agents earn rental income and sales revenue from their land holdings which they spend on traded goods and non-traded goods. It should be noted that young migrants receive the same wage and face the same the price for non-traded goods as do foreign agents. However as young migrants buy the home country's land, they pay the same price for land as do home agents. Of course, all agents regardless of country of residence or immigration status pay the same price for traded goods.

The budget constraints for a home agent who is young in period t can be expressed thus:

When young: $C^{Y}_{T,t} + p_t\, C^{Y}_{NT,t} + q_t\, L^{Y}_{t} \leq w_t$

When old: $C^{O}_{T,t+1} + p_{t+1}\, C^{O}_{NT,t+1} \leq (r_{t+1} + q_{t+1})\, L^{O}_{t+1}$

And with $L^{Y}_{t} = L^{O}_{t+1}$

Where:

p_t is the price of the non-traded good at home at time t

q_t is the price of land at home at time t

w_t is the wage rate at home at time t

r_t is the rental income from land at home at time t

$L_t^Y = L_{t+1}^O$ is the amount of land the agent chooses to buy (in order to rent and sell later)

The budget constraints for a foreign agent who is young in period t can be expressed thus (decision variables of foreign agents are starred):

When young: $C_{T,t}^{Y*} + p_t^* \, C_{NT,t}^{Y*} + q_t^* \, L_t^{Y^*} \leq {w_t}^*$

When old: $C_{T,t+1}^{O*} + p^*{}_{t+1} \, C_{NT,t+1}^{O*} \leq (r_{t+1}^* + q_{t+1}^*) \, L_{t+1}^{O*}$

And with $L_t^{Y^*} = L_{t+1}^{O*}$

Where:

p_t^* is the price of the non-traded good abroad at time t

q_t^* is the price of land abroad at time t

w_t^* is the wage rate abroad at time t

r_t^* is the rental income from land abroad at time t

The budget constraints for a migrant agent who is young in period t can be expressed thus (decision variables of migrants are accented with a tilde):

When young: $\tilde{C}_{T,t}^Y + p_t^* \, \tilde{C}_{NT,t}^Y + q_t \, \tilde{L}_t^Y \leq {w_t}^*$

When old: $\tilde{C}_{T,t+1}^O + p_{t+1} \, \tilde{C}_{NT,t+1}^O \leq (r_{t+1} + q_{t+1}) \, \tilde{L}_{t+1}^O$

And with $\tilde{L}_t^Y = \tilde{L}_{t+1}^O$

L_t^Y equals L_{t+1}^O in every case since the amount of land a young agent buys in period t is the amount of land he can rent and sell as an old agent in period t+1. Prices are normalized in terms of the tradable good which has unit price in both countries.

Therefore, the utility maximization problem of the home agent is:

$$\max_{C_{T,t}^Y; C_{NT,t}^Y; C_{T,t+1}^O; C_{NT,t+1}^O; L_t^Y} \left\{\gamma \log C_{T,t}^Y + (1-\gamma) \log C_{NT,t}^Y + \beta\left[\gamma \log C_{T,t+1}^O + (1-\gamma) \log C_{NT,t+1}^O\right]\right\}$$

Subject to $\quad C_{T,t}^Y + p_t\, C_{NT,t}^Y + q_t\, L_t^Y \leq w_t$

$$C_{T,t+1}^O + p_{t+1}\, C_{NT,t+1}^O \leq (r_{t+1} + q_{t+1})\, L_{t+1}^O$$

$$L_t^Y = L_{t+1}^O$$

Maximization Problem 1

The utility maximization problem of the foreign agent is:

$$\max_{C_{T,t}^{Y*}; C_{NT,t}^{Y*}; C_{T,t+1}^{O*}; C_{NT,t+1}^{O*}; L_t^{Y*}} \left\{\gamma \log C_{T,t}^{Y*} + (1-\gamma) \log C_{NT,t}^{Y*} + \beta\left[\gamma \log C_{T,t+1}^{O*} + (1-\gamma) \log C_{NT,t+1}^{O*}\right]\right\}$$

Subject to $\quad C_{T,t}^{Y*} + p_t^*\, C_{NT,t}^{Y*} + q_t^*\, {L_t^Y}^* \leq {w_t}^*$

$$C_{T,t+1}^{O*} + p_{t+1}\, C_{NT,t+1}^{O*} \leq (r_{t+1}^* + q_{t+1}^*)\, L_{t+1}^{O*}$$

$$L_t^{Y*} = L_{t+1}^{O*}$$

Maximization Problem 2

Therefore, the utility maximization problem of the migrant agent is:

$$\max_{\tilde{C}^Y_{T,t};\tilde{C}^Y_{NT,t};\tilde{C}^O_{T,t+1};\tilde{C}^O_{NT,t+1};\tilde{L}^Y_t} \{\gamma \log \tilde{C}^Y_{T,t} + (1-\gamma)\log \tilde{C}^Y_{NT,t}$$
$$+ \beta\left[\gamma \log \tilde{C}^O_{T,t+1} + (1-\gamma)\log \tilde{C}^O_{NT,t+1}\right]\}$$

Subject to $\tilde{C}^Y_{T,t} + p^*_t\, \tilde{C}^Y_{NT,t} + q_t\, \tilde{L}^Y_t \leq {w_t}^*$

$$\tilde{C}^O_{T,t+1} + p_{t+1}\, \tilde{C}^O_{NT,t+1} \leq (r_{t+1} + q_{t+1})\, \tilde{L}^O_{t+1}$$

$$\tilde{L}^Y_t = \tilde{L}^O_{t+1}$$

Maximization Problem 3

3.3 Land and Production Technology

In each country the amount of land is fixed. Land is immobile and is bought from old agents by young agents wishing to save. Prior to selling it, old agents rent out their land holdings to firms who use it while producing traded goods. The total amount of land in the home country is given by $\bar{L}$ and the total amount of land in the foreign country is given by $\bar{L}^*$.

There are two sectors in each country. The factors of production for the tradable goods sector are land and labor while the non-traded sector requires only labor. Labor is perfectly mobile between sectors in the same country, enforcing a uniform wage for both sectors. Including an immobile factor such as land sector ensures that traded goods are produced in both economies regardless of the relative total factor productivity between the home and foreign country. The non-traded sector too is active in both economies simply because agents desire both types of goods and non-traded goods by definition do not cross borders. Each sector in each country is represented by a perfectly competitive firm that maximizes profits by choosing the amount of labor to hire (and land to rent, for traded goods firms) while producing with a constant returns to scale technology – with a Cobb-Douglas structure for the traded goods sector and a linear form for the non-traded goods sector. The different sectors in different countries have different total factor productivities.

The profit maximization problem for the traded goods sector at home is:

$$\max_{n^D_{T,t}, L^D_{T,t}} A_T \left(L^D_{T,t}\right)^{\theta} \left(n^D_{T,t}\right)^{1-\theta} - r_t \, L^D_{T,t} - w_t \, n^D_{T,t}$$

Maximization Problem 4

Where:

$L^D_{T,t}$ is the amount of land demanded by the home firm in the traded goods sector

$n^D_{T,t}$ is the amount of labor demanded by the home firm in the traded goods sector

A_T is the total factor productivity of the home firm in the traded goods sector

θ is the share of land in production

The profit maximization problem for the traded goods sector abroad is:

$$\max_{n^{D*}_{T,t}, L^{D*}_{T,t}} A^*_T \left(L^{D*}_{T,t}\right)^{\theta} \left(n^{D*}_{T,t}\right)^{1-\theta} - r^*_t \, L^{D*}_{T,t} - w^*_t \, n^{D*}_{T,t}$$

Maximization Problem 5

Where:

$L_{T,t}^{D*}$ is the amount of land demanded by the foreign firm in the traded goods sector

$n_{T,t}^{D*}$ is the amount of labor demanded by the foreign firm in the traded goods sector

A_T^* is the total factor productivity of the foreign firm in the traded goods sector

The profit maximization problem for the non-traded goods sector at home is:

$$\max_{n_{NT,t}^{D}} \quad p_t\, A_{NT}\, n_{NT,t}^{D} - w_t\, n_{NT,t}^{D}$$

Maximization Problem 6

Where:

n_{NT}^{D} is the amount of labor demanded by the home firm in the non-traded goods sector

A_{NT} is the total factor productivity of the home firm in the non-traded goods sector

The profit maximization problem for the non-traded goods sector abroad is:

$$\max_{n_{NT,t}^{D*}} \quad p_t^*\, A_{NT}^* n_{NT,t}^{D*} - w^*\, n_{NT,t}^{D*}$$

Maximization Problem 7

Where:

${n_{NT}^{D}}^*$ is the amount of labor demanded by the foreign firm in the non-traded goods sector

${A_{NT}}^*$ is the total factor productivity of the foreign firm in the non-traded goods sector

Again, it should be noted that all prices (including wage rates and rents) are normalized in terms of the price of the traded good which has a unit price in both countries. As all the firms are competitive, they make zero profits and factors of production are paid their marginal products.

3.4 Remittances

Remittances in this model are the savings made by young migrant agents. The remittance made by each young migrant agent in period t $= q\ \tilde{L}_t^Y$. As the number of young migrant agents in any period is given by α, the total remittances made in period t $= \alpha\ q\ \tilde{L}_t^Y$. The model does not specify to whom exactly each remittance goes. The remittances are received by old agents at home and they include migrants who have retired and are now at home as well as old home agents who never ventured abroad.

3.5 Market Clearing Conditions

Only the market clearing condition for the traded good is common to both countries. All other markets are country specific. Market clearing conditions are:

Traded Goods:

$$(1-\alpha)(C_{T,t}^{Y}+C_{T,t}^{O})+F(C_{T,t}^{Y*}+C_{T,t}^{O*})+\alpha(\tilde{C}_{T,t}^{Y}+\tilde{C}_{T,t}^{O})=A_{T}\left(L_{T,t}^{D}\right)^{\theta}\left(n_{T,t}^{D}\right)^{1-\theta}+A_{T}^{*}\left(L_{T,t}^{D*}\right)^{\theta}\left(n_{T,t}^{D*}\right)^{1-\theta}$$

Non-traded Goods:

Home: $(1-\alpha)(C_{NT,t}^{Y}+C_{NT,t}^{O})+\alpha\left(\tilde{C}_{T,t}^{O}\right)=A_{NT}\,n_{NT,t}^{D}$

Foreign: $F(C_{NT,t}^{Y*}+C_{NT,t}^{O*})+\alpha\left(\tilde{C}_{T,t}^{Y}\right)=A_{NT}^{*}n_{NT,t}^{D*}$

Land for Production:

Home: $(1-\alpha)L_{t}^{O}+\alpha\,\tilde{L}_{t}^{O}=L_{T,t}^{D}=\bar{L}$

Foreign: $FL_{t}^{O*}=L_{T,t}^{D*}=\bar{L}^{*}$

Land for Sales:

Home: $(1-\alpha)L_{t}^{O}+\alpha\,\tilde{L}_{t}^{O}=(1-\alpha)L_{t}^{Y}+\alpha\,\tilde{L}_{t}^{Y}=\bar{L}$

Foreign: $FL_{t}^{O*}=FL_{t}^{Y*}=\bar{L}^{*}$

Labor:

Home: $n_{T,t}^{D}+n_{NT,t}^{D}=(1-\alpha)$

Foreign: $n_{T,t}^{D*}+n_{NT,t}^{D*}=F+\alpha$

Market Clearing Conditions

3.6 Steady State Equilibrium

A Steady State Equilibrium is defined as a set of time-independent prices, wages, rents and allocations for consumption, labor and land such that all maximization problems are solved subject to their respective constraints and all markets clear. The model was solved and a unique steady state was obtained.

4 Calibration and Solution Techniques

Some of the parameters used in this model were assumed due to normalization or obtained from other studies. The share of labor in the production of traded goods was assumed to be 0.7 – this is standard in the literature in general and used in particular for traded goods by Acosta et al (2007) in a remittances model used for detecting Dutch Disease. Amount of land per worker in both countries was assumed to be one – this is the value used by Klein and Ventura (2007) for a model of migration. The total factor productivity in the home country was fixed at one. Similarly, by normalization, the population of young at home was set to one.

Other demographic parameters were computed directly from the data. As South Africa is about 24 times more populous than Lesotho, foreign young population was assigned the value 24. The fraction of young home country citizens who are migrants was calculated from the data to be about 0.2.

The remaining parameters were obtained by solving the model and matching key ratios obtained from the model to corresponding ratios from the data. These ratios were used so that the difference between model time (2 periods equal one lifetime) and data time (one period equals one year) would not affect results. The parameters obtained thus are given in Table 4 and the values of the 'moments' used from the data and the model are given in Table 5. All the variables in the model other than the price for non-traded goods at home were solved for analytically. To solve for price, a computational technique was used such that there was no excess demand in the market for traded goods.

	Moments from Data	**Moments from Model**
Ratio of Traded Sector to Total GDP at Home	0.316	0.316
Ratio of Home to Foreign GDP per capita	0.233	0.234
Ratio of Remittances to GDP	0.253	0.255
Real Exchange Rate	1.58	1.58

Table 4

Parameters obtained from model solution	
Discount factor for old utility (β)	0.463
Traded TFP abroad (At*)	4.343
Non-traded TFP abroad (Ant*)	1.544
Weight parameter for traded goods (γ)	0.456

Table 5

Some of the moments that were not matched explicitly also yielded similar values for the data and model. These are given in Table 6. The discount factor for old utility obtained implies that the duration of working age is about 15 years if we assume the common value of 0.95 for annual discount. This number has some support from the data due to the fact that the average tenure of a Masotho miner is between 13 and 16 years according to Van der Weil (1977).

	Moments from Data	**Moments from Model**
Ratio of Home Traded to Foreign Traded	0.012	0.01
Ratio of Home Non-traded to Foreign Non-traded	0.009	0.011

Table 6

5 Results and Implications

Once the model was solved numerous exercises were conducted in order to obtain a better understanding of the causes and impact of remittances.

For the first exercise, the total factor productivity of the traded sector abroad was changed. This led to an increase in remittances, an appreciation of the real exchange rate and a decrease in the share of traded goods produced at home. This indicates that when the foreign country becomes more productive in the traded goods sector, migrants remit more traded goods to their home country and in turn the home country manufactures fewer traded goods. Figure 5 below shows this graphically.

The term '% Deviation' used in the figure refers to how different the value under consideration is in the alternative scenario compared to the corresponding value obtained through model solution discussed in the previous section. Also, ‘Home structure of Production’ is defined as the ratio of the value of traded goods manufactured at home to the value of the total GDP at home. Thus, to obtain the first points on Figure 1, all parameters were kept the same as in the calibrated solution except for the TFP of the traded sector abroad. This TFP was first by decreased by 1% (a change of -1%) and the values of the variables obtained thus were compared in percent terms to their values from the original calibrated solution. These percent changes were then plotted (on the y-axis) versus the corresponding percent change of TFP (on the x-axis).

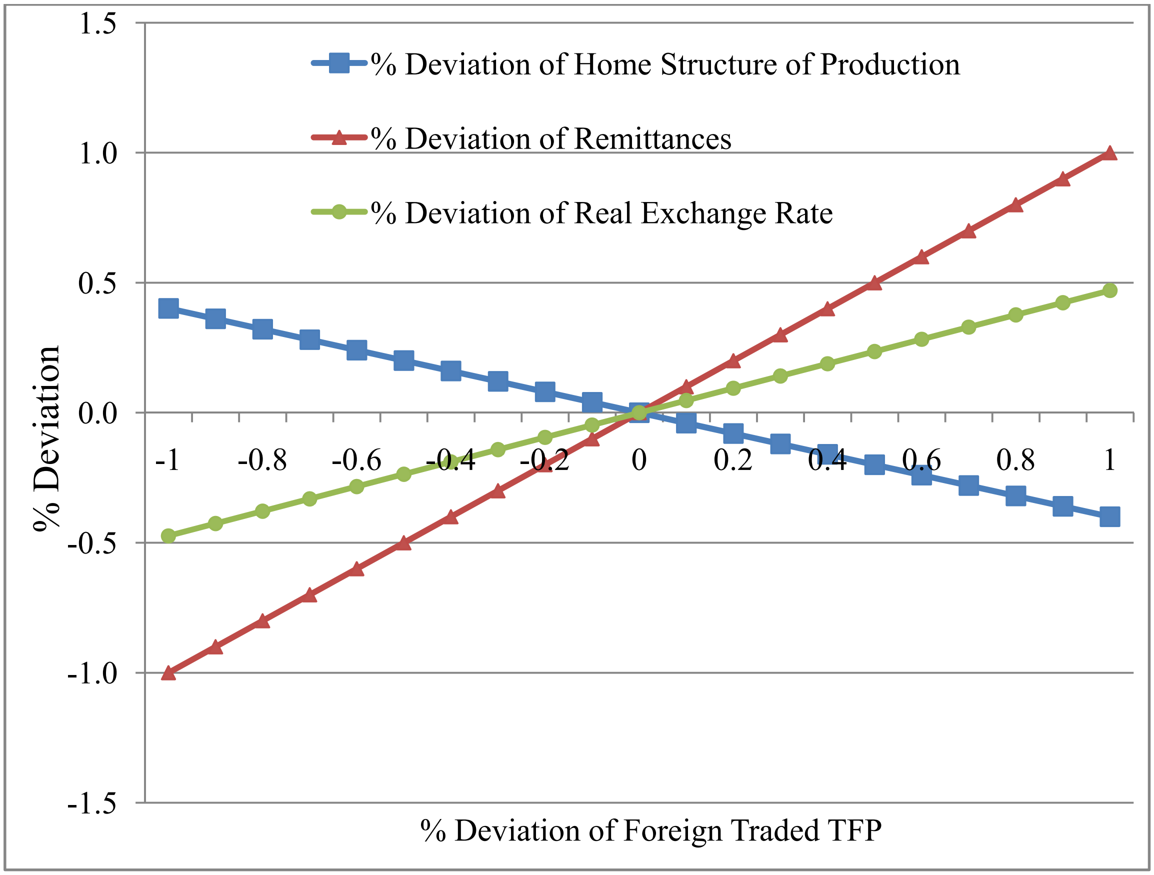


Figure 19

Next, the total factor productivity of the non-traded sector was changed abroad. This caused no change in remittances, a depreciation of the real exchange rate and no change in the share of traded goods in home production. This implies that when the foreign country becomes more productive in the non-traded goods sector, migrants do not remit more traded goods to their home country and the home country's structure of production stays unchanged as well. Please refer to Figure 6.

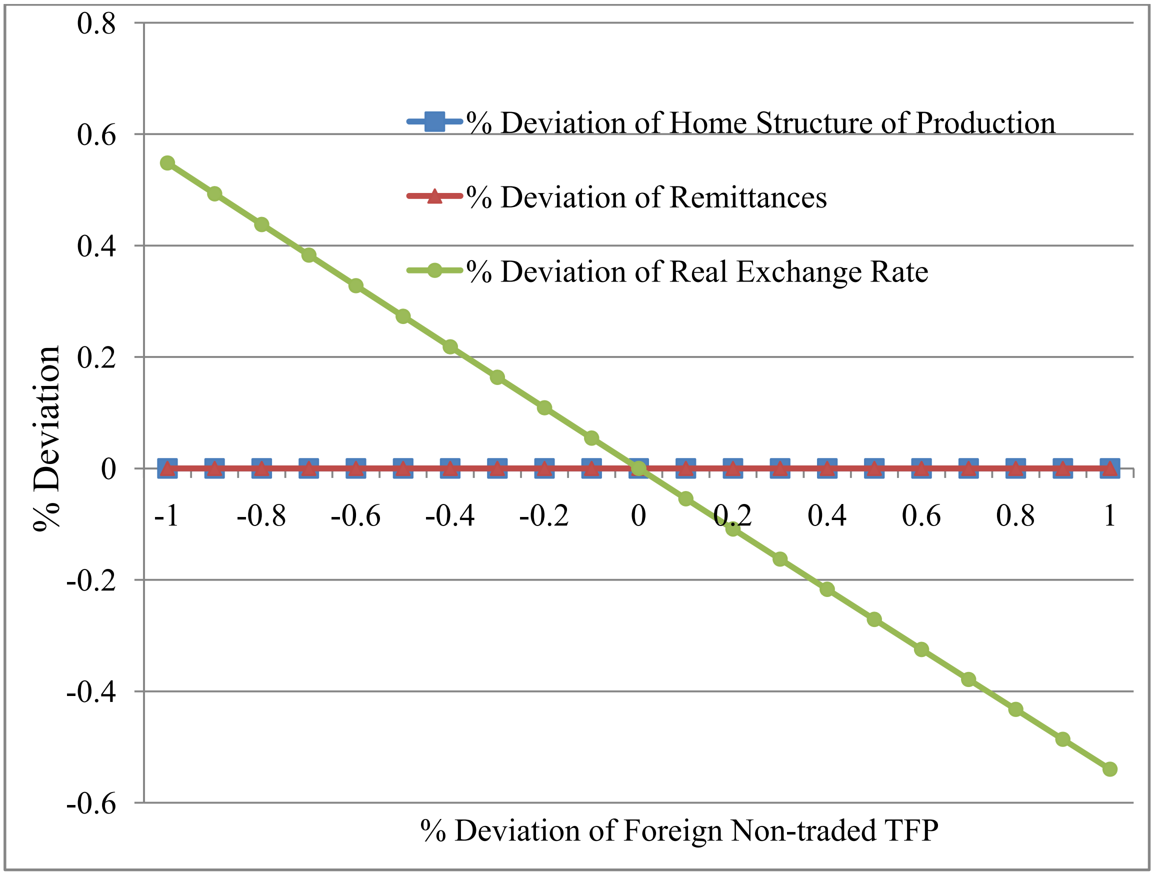


Figure 20

The total factor productivity of the traded sector at home was changed next. Again, remittances stayed unchanged while the real exchange rate depreciated and share of traded goods produced at home increased. Thus, when the home country becomes more productive in the traded goods sector, migrants do not change their remittances. The home country's structure of production however changes as more traded goods are produced. These results can be seen in Figure 7.

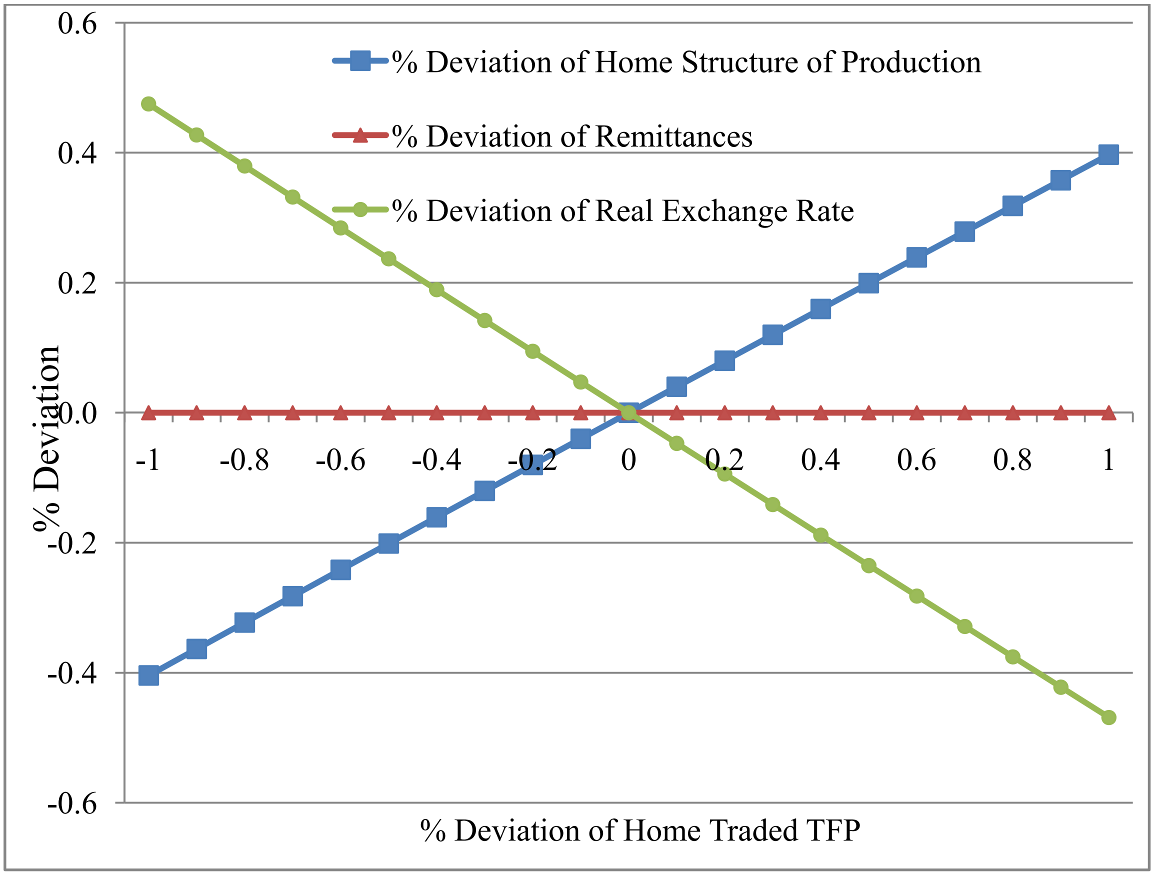


Figure 21

Finally, the total factor productivity of the non-traded sector at home was changed. This also resulted in unchanged remittances. The real exchange rate appreciated and there was no change in the share of traded goods in home production. This indicates that when the home country becomes more productive in the traded goods sector, migrants do not change their remittances and the home country's structure of production also stays unchanged. Figure 8 displays these results.

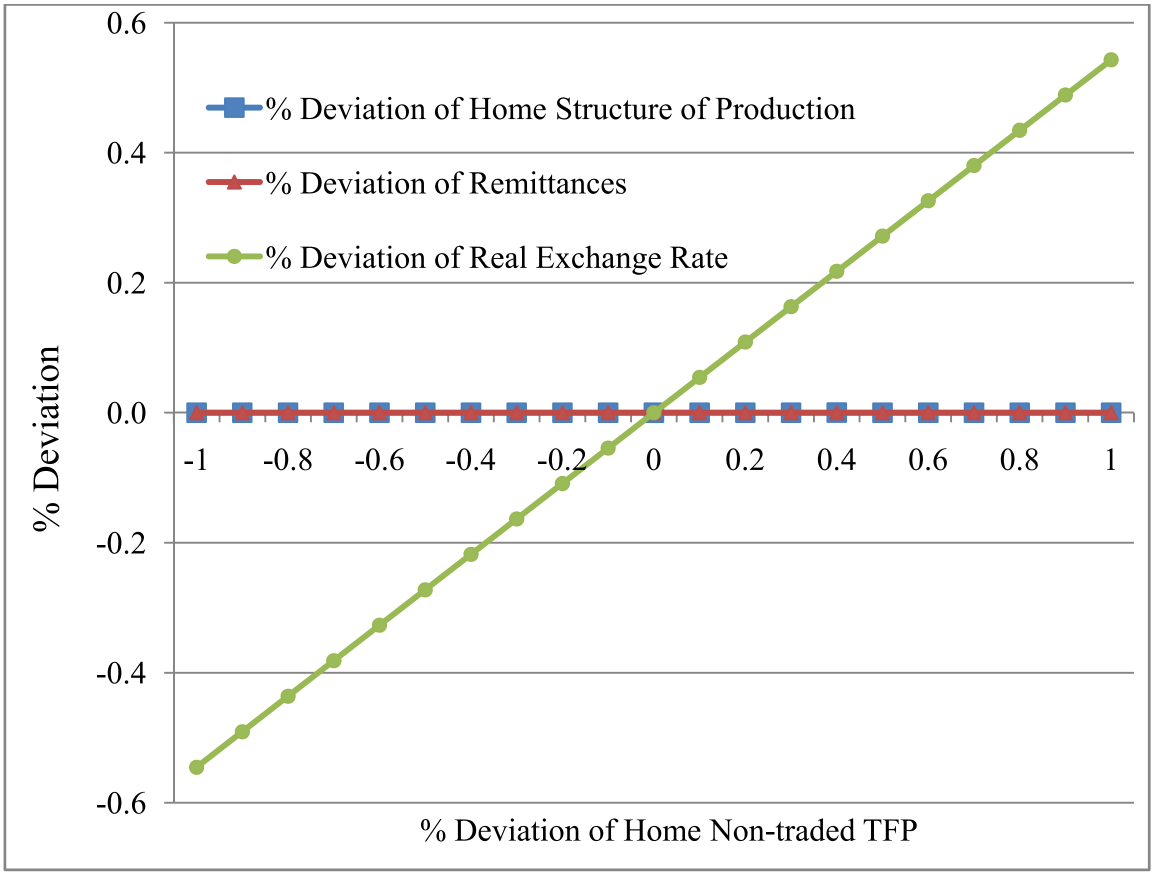


Figure 22

Together, these graphs indicate that remittances do not change with any change in the TFPs at home and rise only when traded TFP changes abroad. The real exchange rate appreciates when the foreign traded sector or home non-traded sector becomes more productive. Conversely, the real exchange rate depreciates when the foreign non-traded sector or home non-traded sector becomes more productive. The share of the traded sector at home is positively related with its own TFP and negatively related with foreign traded TFP. The share of the traded sector does not change with any change in the non-traded TFPs.

In order to study how the volume of migration affects remittances and other variables, an exercise similar to the ones above was conducted, this time by varying alpha (the percent of young home citizens who are migrants) and recording its impact on different variables of interest. These results are shown in Figure 9.

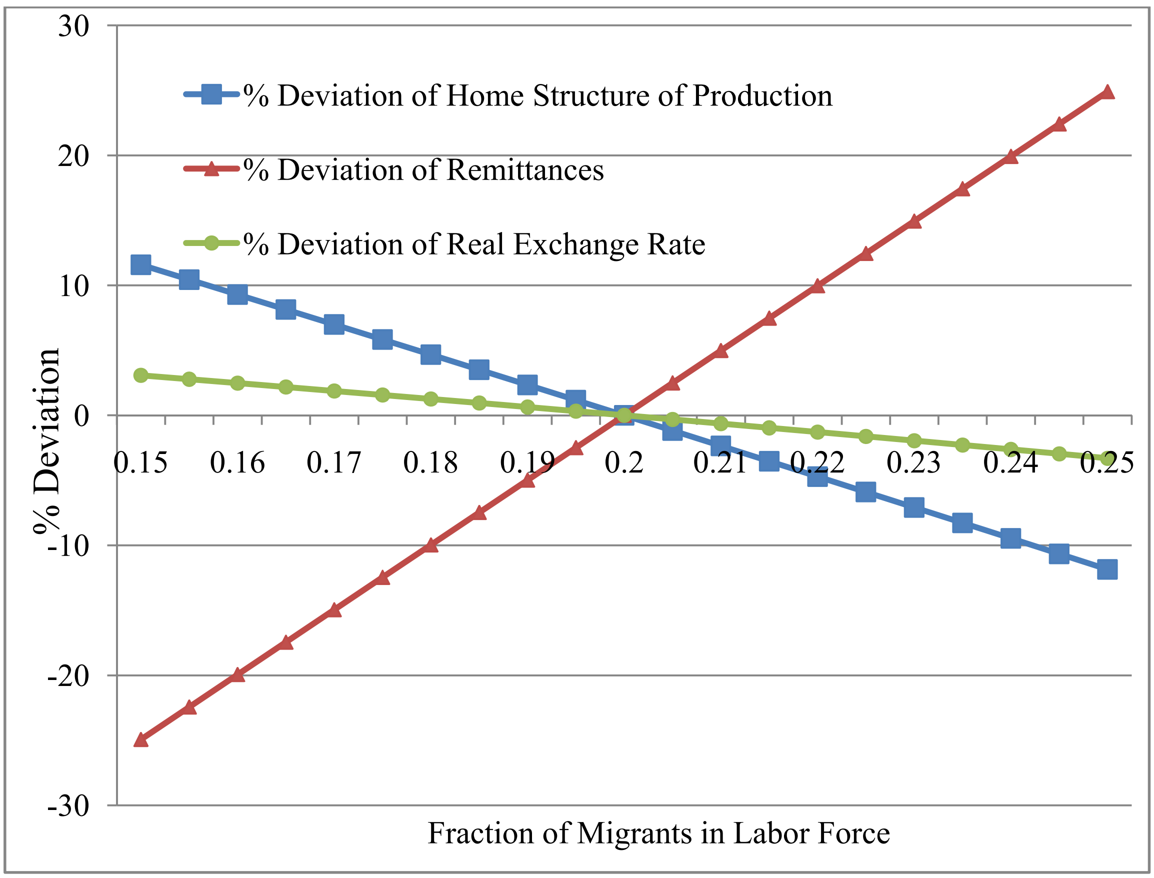


Figure 23

Predictably, as migration increases, so do remittances. When remittances increase due to increased migration, there is some evidence of the Dutch Disease as the traded sector at home shrinks (although an increase in migration also results in a depreciation of the real exchange rate). This corroborates the various empirical and theoretical studies discussed in previous sections and suggests that concerns about the Dutch disease may be indeed founded. However, on closer examination it can be seen that despite the Dutch disease, the home country welfare increases significantly from increased migration. Welfare gain here is defined in terms of the composite consumption good per period. While home agents gain from increased migration the same does not hold true for foreign agents and migrants as can be seen from Figures 10, 11 and 12.

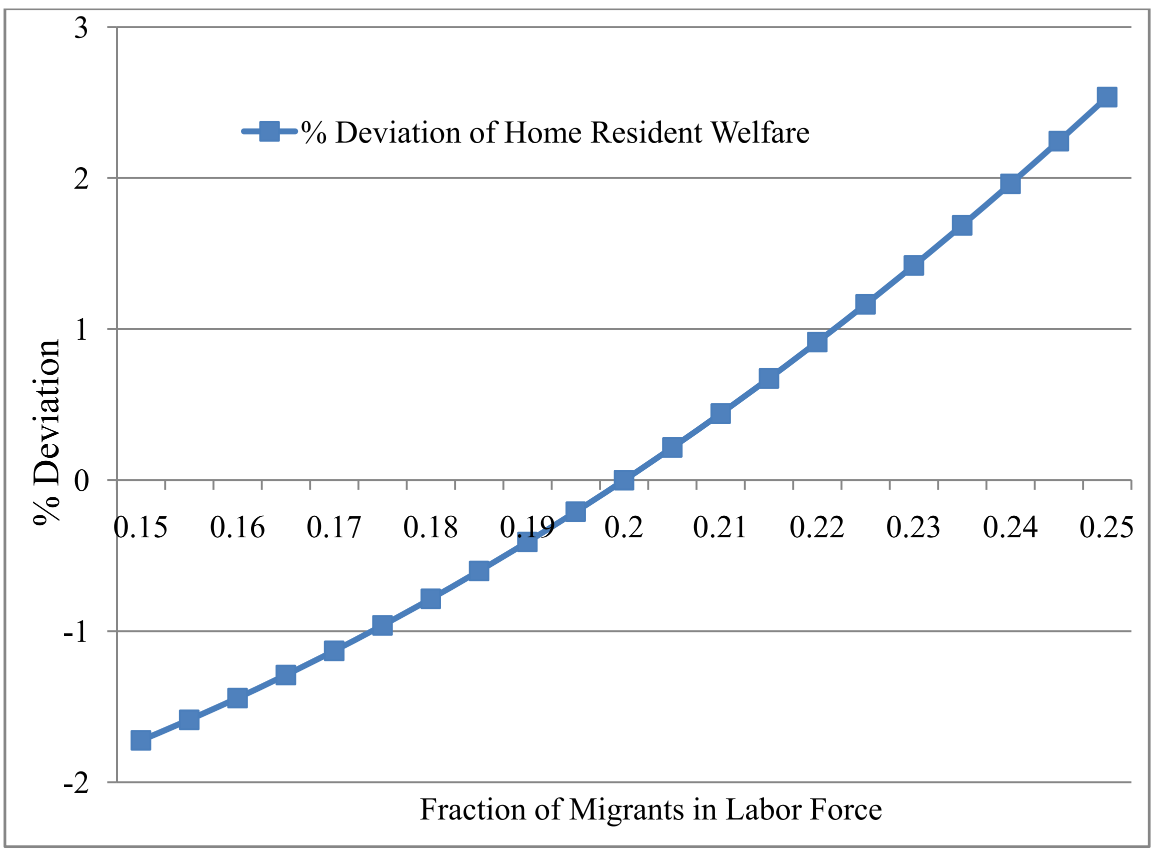
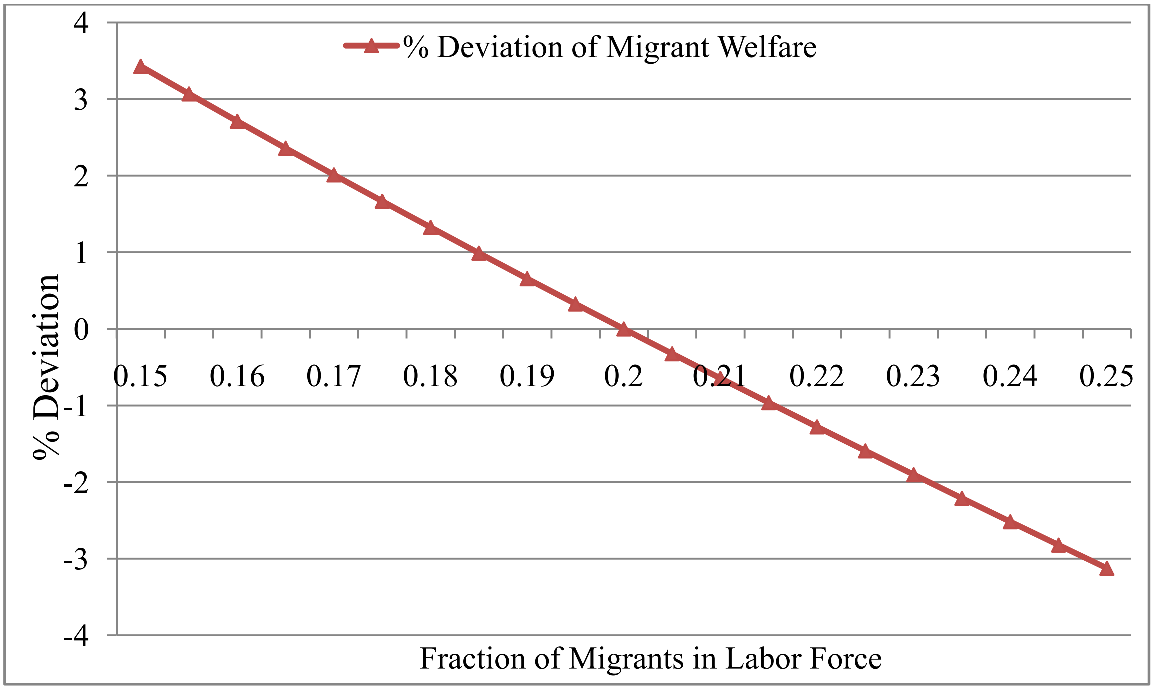


Figure 24



% Deviation of Migrant Welfare
% Deviation
4
3
2
1
0
-1
-2
-3
-4
0.15
0.16
0.17
0.18
0.19
0.2
0.21
0.22
0.23
0.24
0.25
Fraction of Migrants in Labor Force

Figure 25

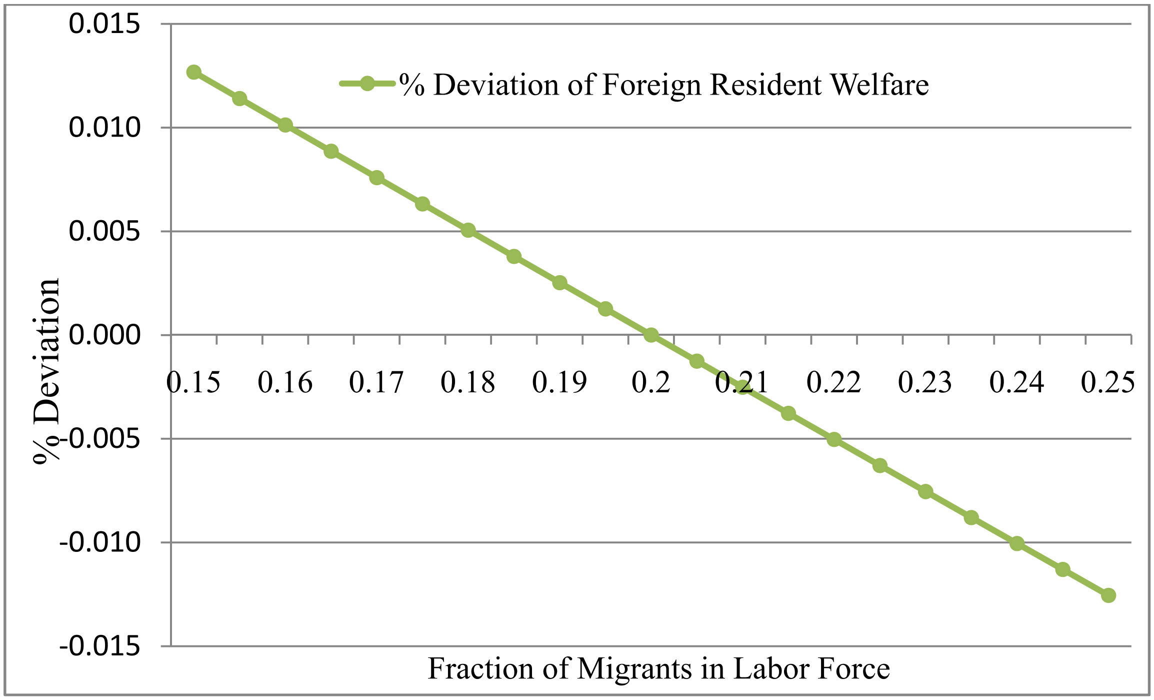


Figure 26

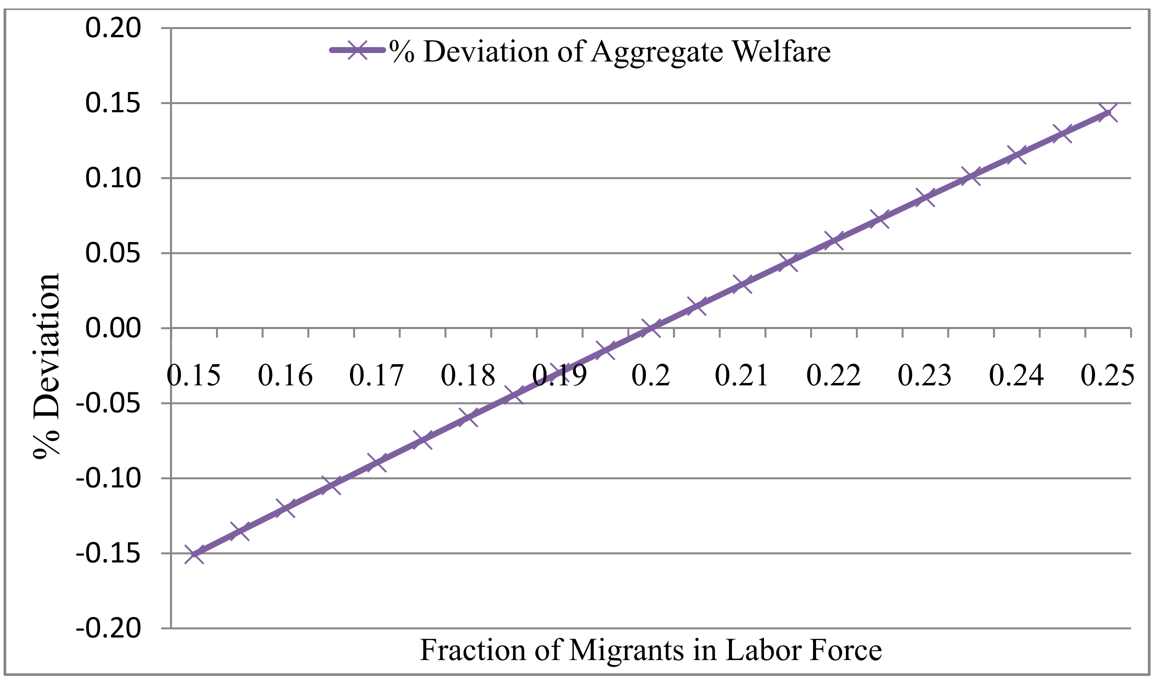


Figure 27

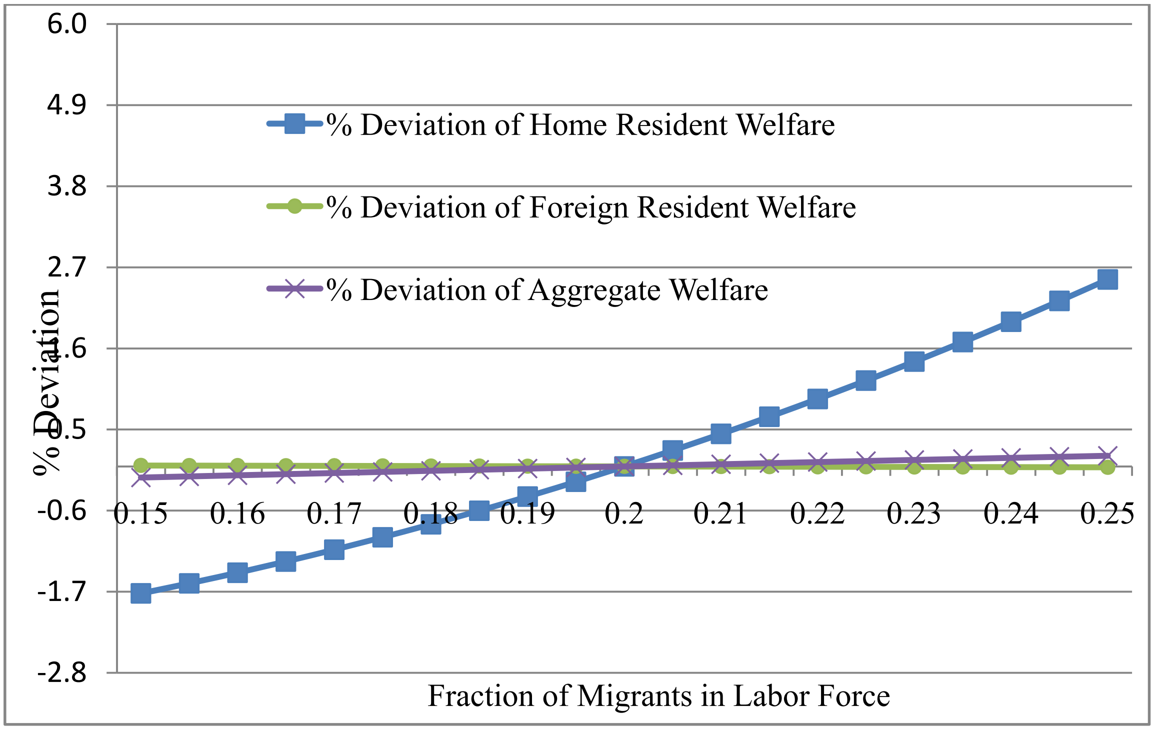


Figure 28

Aggregate welfare on the other hand, obtained by summing up population-weighted welfare increases significantly with an increase in migration as can be seen in Figure 13. In fact, when plotted on the same scale as in Figure 14, it can be seen that the benefits of increased migration for home agents is orders of magnitude greater than the costs of increased migration for foreign agents.

This suggests that allowing more immigrant workers from a poor economy might be an effective way to boost the welfare of its agents. To test this quantitatively, another counterfactual exercise was conducted. Instead of allowing migration, the foreign country is now made to donate a certain amount of foreign aid to the home country. The exact amount of foreign aid is determined such that it would leave home country agents' welfare unchanged when compared to the situation in which migration is allowed but no aid is transferred. The foreign country's government extracts the foreign aid through equal lump sum taxation of all its citizens and then transfers this aid to the home country government which in turn provides equal lump sum transfers to all its citizens. Results of this exercise are given in Table 7.

Decrease in welfare of foreign citizens when aid used instead of migration	1.2%
Percent of output that needs to be transferred as foreign aid	0.8%

Table 7

The overall results of the model and the above exercises in particular suggest that remittances are very effective in boosting the welfare of recipient economies despite any occurrence of the Dutch Disease. Also, from a donor country's standpoint, allowing greater migration from the recipient country is preferable to sending it foreign aid.

5.1 The Road Ahead and Future Work

While this model provides good intuition, it does not capture dynamic and stochastic effects. A computable model that incorporates these features can provide more accurate results. Capital could also be added to the model instead of or in addition to land. With capital included in the model, agents can respond to changes in migration by adjusting their behavior in terms of capital as well. By adding a labor-leisure choice, this model can also be used to test whether remittances cause a decrease in the total labor hours in the recipient country. Finally, this model considers only one source of remittances – that of savings by migrants who return to their home country for retirement. This is indeed applicable for some countries such as UAE, where migrant workers have restricted land ownership rights and cannot become permanent residents. However, an alternative model that allows remittances to be driven by other motives such as altruism would be more widely applicable. In the next chapter, an altruism-based model of remittances is studied.

The Macroeconomic Impact of Migrant Remittances in an Altruistic Model

This chapter is closely related to the previous one as this exercise too studies the impact of migrant remittances on welfare, consumption, savings and the structure of production between traded and non-traded sectors in both the remittance sending and the remittance receiving countries. Once again, micro foundations are used to model remittances which in this chapter are driven by family decisions rather than through the savings motive of migrants. In order to facilitate convenient and accurate comparisons with the previous chapter, a similar steady state model is constructed, solved and calibrated with data from South Africa and Lesotho. The results show that remittances are influenced by the economic prospects in the both the host country and the recipient country in the altruistic framework. As with the previous chapter, restricting migration reduces both home country and aggregate welfare even though migrant remittances contribute to 'Dutch Disease.' In this model, the citizens of the host country would suffer an even more severe welfare loss (3.7% as opposed to 1.2% in the overlapping-generations model) in terms of per period consumption if they were to choose assisting the recipient country with foreign aid instead of allowing migration.

1 Introduction

In the previous chapter, the relevance of remittances and some of the major areas of current research in the area were discussed. In this paper, it is assumed that remittances are driven by altruism rather than savings motives. However, the questions posed are similar – what macroeconomic factors drive remittances, do remittances cause Dutch Disease and what are the welfare effects of remittances?

The model used is deliberately constructed to closely match the previous model so as to facilitate convenient comparisons. The model has two sectors (traded and non-traded), two countries (host/sending/foreign and home/recipient) and dynastic households rather than overlapping-generations. The households of the home country have a certain fraction of their members working as migrants in the host country. Households maximize a household-level problem and this can be thought of as implying altruistic behavior among the members. Similarly, since households are dynasties, the model features inter-generational altruism as well. Thus, a home country household's optimal solution might involve transfers from its migrant members to its resident members and this is modeled as remittances in this paper.

As in the previous paper, data from South Africa and Lesotho are used to calibrate the model and estimate parameters. The solution of this model also suggests that remittances are welfare enhancing despite their contribution to the phenomenon of

Dutch Disease. However, the gains from remittances are higher in this model and moreover, this model yields the interesting result that even foreign households gain from increased migration. Thus, the results of previous chapter are magnified in this chapter and here, the host country gains even higher welfare by allowing migration from the home country rather than providing it equivalent foreign aid.

1.1 Related Literature

The general literature pertaining to remittances in a macroeconomic framework was discussed in the previous chapter. The primary difference between this and the previous chapter pertains to savings motives. Rapoport and Docquier (2005) present a very detailed and methodical discussion of the various possible motives behind remittances. These include altruism, exchange for services provided in the home country, as a strategy to deter more migration, as an insurance arrangement, as a family loan arrangement where the migrant repays his debt to the family, as a means to retain the rights of inheritance etc. After closely studying evidence from microeconomic literature and empirical studies of survey data, Rapoport and Docquier (2005) conclude:

> *On the whole, the evidence from micro surveys confirms that patterns of remittances are better explained as familial inter-temporal contracts than as a result of altruism or other purely individualistic considerations. This is not to deny the importance of individualistic motives, however, since*

altruism, intentions to return, and prospects for inheritance explain why implicit migration contracts emerge mainly if not exclusively within a familial context.

In this paper, 'altruism' is not used in the strict sense of Rapoport and Docquier (2005). Rather, the word altruism is used to suggest a familial motive for remittances; this is clear from the model (described in the next section) which features household level decision making and utility maximization. This approach abstracts away from intra-household game theoretic elements while maintaining the relevance of the family since a household can be thought of as an arrangement where a household-level benevolent dictator makes all decisions and is constrained only by the entire household's budget.

As the data have been discussed in the previous chapter, the next section presents the model. Section three provides details regarding the calibration while the results and implications of the model are discussed in the fourth section.

3 Model

The data are analyzed using a two-country, two-sector, general equilibrium model with perpetually lived household-dynasties. All dynasties in a given country are assumed to be identical. A constant fraction of the members of a home household-dynasty is situated as migrants in the foreign country. Remittances in this model take the form of the effective transfers made by a migrant to the rest of her home household. To permit easy comparison, all other features of the model are left unchanged from the previous chapter. Thus, the model abstracts away from capital and as all dynasties in a given country are identical, each owns a fixed fraction of the land. As in the previous model, land in a particular country can only be bought and sold by a household belonging to that country. However, as all households in this model are identical, land is not bought or sold in any period. Hence land markets are ignored in the model and each household is given a fixed perpetual share of land. Although this model can be easily extended to a dynamic framework, in order to retain the similarity with the model in the previous chapter all parameters (most notably, the TFPs) and the resultant variables are assumed to be time independent. Since none of the decisions are inter-temporal, this model reduces to a very simple general equilibrium model that can be solved analytically. Yet, the model is rich in terms of the features it can be used to study and understand – especially after it is calibrated from actual data.

3.1 Households

This decision making unit in this model is the household rather than the agent. All households in a given country are identical and all members within a household are considered to be working age. Since the previous model included equal numbers of working and non-working agents, in order to stay consistent, every agent in this model is endowed with only 0.5 units of labor (as opposed to the 1 unit of the previous paper). Thus, the effective labor force to population ratio for this model too is 0.5. The model has two kinds of households – home households and foreign households:

- Home households – a fraction of each household resides abroad as migrants. The rest of the household stays in the home country. Unlike the previous model, there are no overlapping-generations and each home household member can either be a working migrant or a working resident and is endowed with 0.5 units of labor. This labor is supplied inelastically in order to earn wages. Migrants earn the foreign wage rate while residents earn the home wage rate. These wages are pooled together and used to finance the consumption of traded and non-traded goods both by migrants (who obtain non-traded goods from the foreign country at foreign prices) and residents (who get their non-traded good from home at home prices).
- Foreign households – All members of foreign households stay in the country. Again, unlike the previous model, there are no distinctions between retired and working members – all members are considered to be working and are each endowed with 0.5 units of labor for consistency with the previous model. This labor is supplied inelastically in order to earn wages. These wages are used to finance the consumption of traded and non-traded goods by members of the foreign household.

As with the previous chapter, populations are normalized in terms of the number of home country citizens (citizens include home agents and migrants), which is given a value of 2. The demographic structure can be described thus:

Total population of home country citizens = 2

Fraction of citizens that are migrants = α

Total population of home country citizens = 2 x F

Effective labor force to population ratio for each country = 0.5

3.2 Preferences and Budget Constraints

Rather than individuals maximizing their utility, preferences in this model are given in terms of households. The household planner collects all the resources and redistributes them to maximize a household level utility function.

The model allows the planner of the home household to assign different weights to the migrants and residents. The weights assigned by the planner are assumed to be proportional but not equal to the population weights as migrants and residents may have different bargaining powers due to their differences in income.

Utility for the home household is therefore derived as the appropriately weighted sum of migrant and resident utilities, which in turn are derived through the consumption of a composite good that aggregates tradable goods and non-tradable goods. As in the previous model, the consumption aggregator is of CES (constant elasticity of substitution) form with unit elasticity of substitution. The utility function of the home household is given by:

$$U = (1-\delta)(1-\alpha)[\gamma \log C_T + (1-\gamma)\log C_{NT}] + \delta\, \alpha\, [\gamma \log \tilde{C}_T + (1-\gamma)\log \tilde{C}_{NT}]$$

Where:

γ is the share of tradable goods in total consumption

δ is preference weight for migrants

C_T is the quantity of tradable goods consumed by the resident

C_{NT} is the quantity of non-tradable goods consumed by the resident

$\tilde{C}_T$ is the quantity of tradable goods consumed by the migrant

$\tilde{C}_{NT}$ is the quantity of non-tradable goods consumed by the migrant

This formulation ensures that the weight assigned per migrant and the weight assigned per resident stay the same regardless of the value of α. While conducting welfare calculations with changes in α, the utility value was scaled to ensure that comparisons were being made in terms of a constant household size.

Utility for the foreign household is more straightforward as all members are weighted equally. The utility function of the foreign household is given by:

$$U^* = [\gamma \log C_T^* + (1-\gamma)\log C_{NT}^*]$$

Where:

C_T^* is the quantity of tradable goods consumed by the foreign resident

C_{NT}^* is the quantity of non-tradable goods consumed by the foreign resident

The budget constraint faced by the home household planner is given by:

$$(1-\alpha)[C_T + p\, C_{NT}] + \alpha\left[\tilde{C}_T + p^*\, \tilde{C}_{NT}\right] \;\leq\; (1-\alpha)\frac{w}{2} + \alpha\, \frac{w^*}{2} + r\, L$$

Where:

p is the price of non-traded good in home country

p^* is the price of non-traded good in foreign country

w is the wage rate in home country

w^* is the wage rate in foreign country

r is the rent in home country

L is the amount of land owned by the home household

As can be seen, the planner is able to collect all the income – the wages earned at home by the (1-α) home residents who are each endowed with half a unit of labor, the wages earned abroad by α migrants who are also each endowed with half a unit of labor and the rent earned from the land. After collecting the income, the planner decides how much migrants and residents can consume though she has to keep in mind that the prices of non-traded goods differ in the two countries. The budget constraint faced by the foreign household planner is straightforward and is given by:

$$C_T^* + p^* C_{NT} \;\;\leq\;\; \frac{w^*}{2} + r^*\, L^*$$

Where:

L^* is the land owned by a foreign household

Therefore the utility maximization problem of the home household is:

$$\max_{C_T;C_{NT};\tilde{C}_T;\tilde{C}_{NT}} \{(1-\delta)(1-\alpha)[\gamma \log C_T + (1-\gamma) \log C_{NT}] + \delta\, \alpha\, [\gamma \log \tilde{C}_T + (1-\gamma) \log \tilde{C}_{NT}]\}$$

$$\text{Subject to} \quad (1-\alpha)[C_T + p\, C_{NT}] + \alpha\left[\tilde{C}_T + p^*\, \tilde{C}_{NT}\right] \leq (1-\alpha)\frac{w}{2} + \alpha\, \frac{w^*}{2} + r\, L$$

Maximization Problem 1

And the utility maximization problem of the foreign household is:

$$\max_{C_T^*;C_{NT}^*} \gamma \log C_T^* + (1-\gamma) \log C_{NT}^*$$

$$\text{Subject to} \quad C_T^* + p^* C_{NT} \leq \frac{w^*}{2} + r^*\, L^*$$

Maximization Problem 2

3.3 Land and Production Technology

The model is identical to the one of the previous chapter in terms of the production and technology side. However, this has been discussed again below in order to present the full set of equations.

The total amount of land in the home country is given by $\bar{L}$ and the total amount of land in the foreign country is given by $\bar{L}^*$.

There are two sectors in each country. The factors of production for the tradable goods sector are land and labor while the non-traded sector requires only labor. Labor is perfectly mobile between sectors in the same country, enforcing a uniform wage for both sectors. Each sector in each country is represented by a perfectly competitive firm that maximizes profits by choosing the amount of labor to hire (and land to rent, for traded goods firms) while producing with a constant returns to scale technology – with a Cobb-Douglas structure for the traded goods sector and a linear form for the non-traded goods sector. The different sectors in different countries have different total factor productivities.

The profit maximization problem for the traded goods sector at home is:

$$\max_{n_T^D, L_T^D} A_T \, (L_T^D)^{\theta} (n_T^D)^{1-\theta} - \, r \, L_T^D - w \, n_T^D$$

Maximization Problem 3

Where:

L_T^D is the amount of land demanded by the home firm in the traded goods sector

n_T^D is the amount of labor demanded by the home firm in the traded goods sector

A_T is the total factor productivity of the home firm in the traded goods sector

θ is the share of land in production

The profit maximization problem for the traded goods sector abroad is:

$$\max_{n_T^{D*}, L_T^{D*}} A_T^* \, (L_T^{D*})^{\theta} (n_T^{D*})^{1-\theta} - \, r^* \, L_T^{D*} - w^* \, n_T^{D*}$$

Maximization Problem 4

Where:

L_T^{D*} is the amount of land demanded by the foreign firm in the traded goods sector

n_T^{D*} is the amount of labor demanded by the foreign firm in the traded goods sector

A_T^* is the total factor productivity of the foreign firm in the traded goods sector

The profit maximization problem for the non-traded goods sector at home is:

$$\max_{n_{NT}^D} \quad p \, A_{NT} \, n_{NT}^D - \, w \, n_{NT}^D$$

Maximization Problem 5

Where:

n_{NT}^D is the amount of labor demanded by the home firm in the non-traded goods sector

A_{NT} is the total factor productivity of the home firm in the non-traded goods sector

The profit maximization problem for the non-traded goods sector abroad is:

$$\max_{n_{NT}^{D*}} p^* A_{NT}^* n_{NT}^{D*} - w^* n_{NT}^{D*}$$

Maximization Problem 6

Where:

${n_{NT}^{D}}^*$ is the amount of labor demanded by the foreign firm in the non-traded goods sector

${A_{NT}}^*$ is the total factor productivity of the foreign firm in the non-traded goods sector

Again, it should be noted that all prices (including wage rates and rents) are normalized in terms of the price of the traded good which has a unit price in both countries. As all the firms are competitive, they make zero profits and factors of production are paid their marginal products.

3.4 Remittances

Remittances in this model are given by the difference between the income and consumption of the migrant fraction of home households. This is given by:

$$\alpha \frac{w^*}{2} - \alpha \left[\tilde{C}_T + p^* \tilde{C}_{NT}\right]$$

As the number of households is given by 2, the total remittances are given by:

$$2 \{\alpha \frac{w^*}{2} - \alpha \left[\tilde{C}_T + p^* \tilde{C}_{NT}\right]\}$$

3.5 Market Clearing Conditions

Only the market clearing condition for the traded goods is common to both countries. All other markets are country specific. Market clearing conditions are:

Traded Goods:

$$2\,(1-\alpha)\,C_T + 2\,\alpha\,\tilde{C}_T + 2\,F\,C_T^* = A_T\,(L_T^D)^{\theta}(n_T^D)^{1-\theta} + A_T^*\,(L_T^{D*})^{\theta}(n_T^{D*})^{1-\theta}$$

Non-traded Goods:

Home: $2\,(1-\alpha)\,C_{NT} = A_{NT}\,n_{NT}^D$

Foreign: $2\alpha\tilde{C}_{NT} + 2FC_{NT}^* = A_{NT}^* n_{NT}^{D*}$

Land for Production:

Home: $2L = \bar{L}$

Foreign: $2FL^* = \bar{L}^*$

Labor:

Home: $(1-\alpha) = n_T^D + n_{NT}^D$

Foreign: $F + \alpha = n_T^{D*} + n_{NT}^{D*}$

Market Clearing Conditions

3.6 Steady State Equilibrium

A Steady State Equilibrium is defined as a set of time-independent prices, wages, rents and allocations for consumption, labor and land such that all maximization problems are solved subject to their respective constraints and all markets clear. The model was solved and a unique steady state was obtained.

4 Calibration and Solution Techniques

As in the previous chapter, some of the parameters used in this model were assumed due to normalization or obtained from other studies. The share of labor in the production of traded goods was assumed to be 0.7. The amount of land per worker in both countries was assumed to be one. The total factor productivity in the home country was fixed at one. Similarly, by normalization, the population at home was set to 2. The demographic parameters were computed directly from the data. As South Africa is about 24 times more populous than Lesotho, foreign population was assigned the value 48 (as home was assigned a value of 2). The fraction of home country citizens who are migrants was also set to 0.2 as in the previous chapter.

The remaining parameters were obtained by solving the model and matching key ratios to corresponding ratios from the data. The same ratios are chosen for this chapter as for the previous chapter. The only parameter that is different in this model is δ, the weight assigned by the home household planner to a migrant (relative to 1- δ, the weight for of the resident). This parameter replaces β, used in the previous model as the preference weight for old migrants. As the value obtained for δ is greater than 0.5, it indicates that the planner weights migrant utilities higher than resident utilities.

The parameter values are given in Table 1 and the values of the 'moments' used from the data and the model are given in Table 2.

	Moments from Data	Moments from Model
Ratio of Traded Sector to Total GDP at Home	0.316	0.316
Ratio of Home to Foreign GDP per capita	0.233	0.233
Ratio of Remittances to GDP	0.253	0.253
Real Exchange Rate	1.58	1.58

Table 1

Parameters obtained from model solution	
Preference weight for migrants (δ)	0.644
Traded TFP abroad (At*)	4.396
Non-traded TFP abroad (Ant*)	1.567
Weight parameter for traded goods (γ)	0.454

Table 2

Some of the moments that were not matched explicitly also yielded similar values for the data and model. These are given in Table 3.

	Moments from Data	Moments from Model
Ratio of Home Traded to Foreign Traded	0.012	0.01
Ratio of Home Non-traded to Foreign Non-traded	0.009	0.011

Table 3

5 Results and Implications

After the model was solved, numerous exercises similar to the ones in the last chapter were conducted in order to obtain a better understanding of the causes and impact of remittances in an altruistic model. The results were then compared to those obtained in the last chapter as well.

Changing the foreign traded sector's total factor productivity led to an increase in remittances, an appreciation of the real exchange rate and a decrease in the share of traded goods produced at home. This indicates that when the foreign country becomes more productive in the traded goods sector, migrants remit more traded goods to their home country and in turn the home country manufactures fewer traded goods. Figure 1 below shows this graphically. This result was not different qualitatively from the corresponding result of the previous chapter, however in terms of magnitude, remittances and the structure of production changed more for a given change in TFP while the real exchange rate changed less.

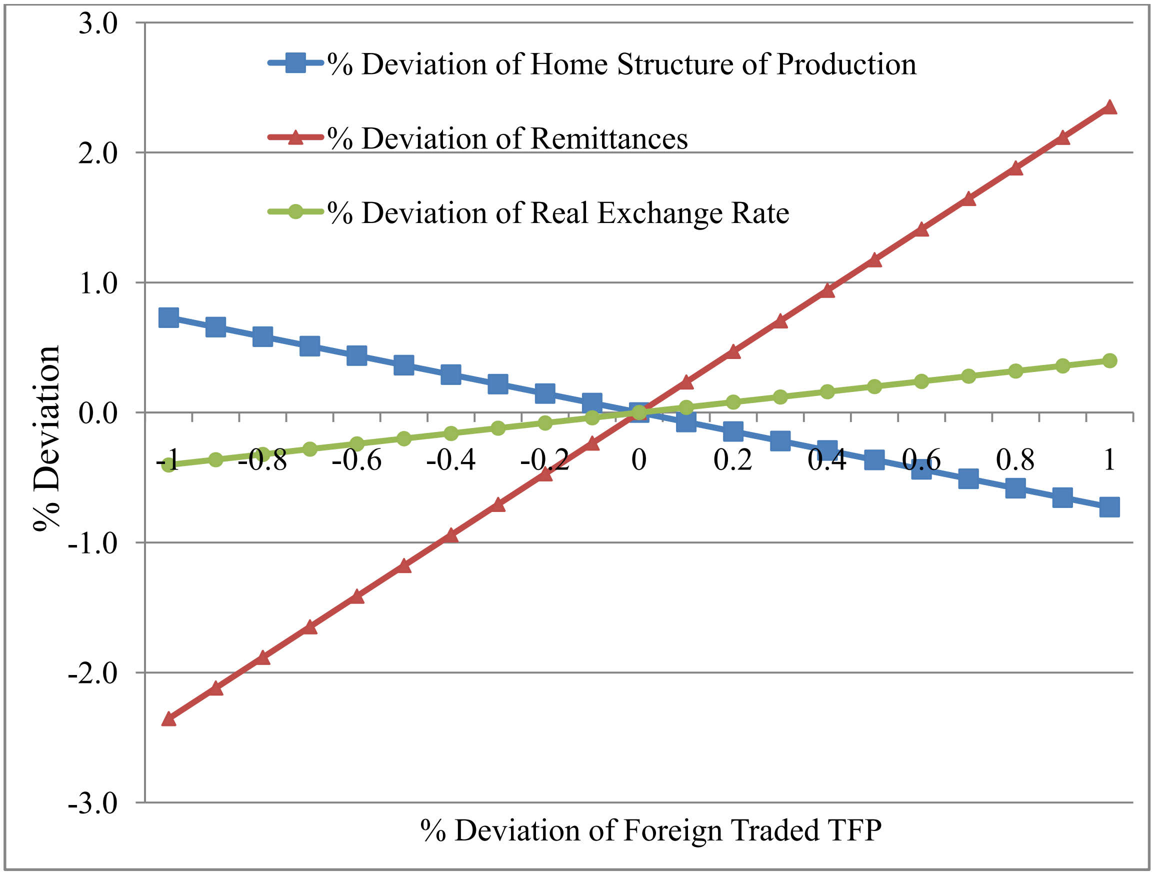


Figure 1

Changing the total factor productivity of the non-traded sector abroad yielded almost identical results for both the altruistic and the overlapping-generations model. The only variable under consideration that changed along with the TFP change was the real exchange rate. Please refer to Figure 2.

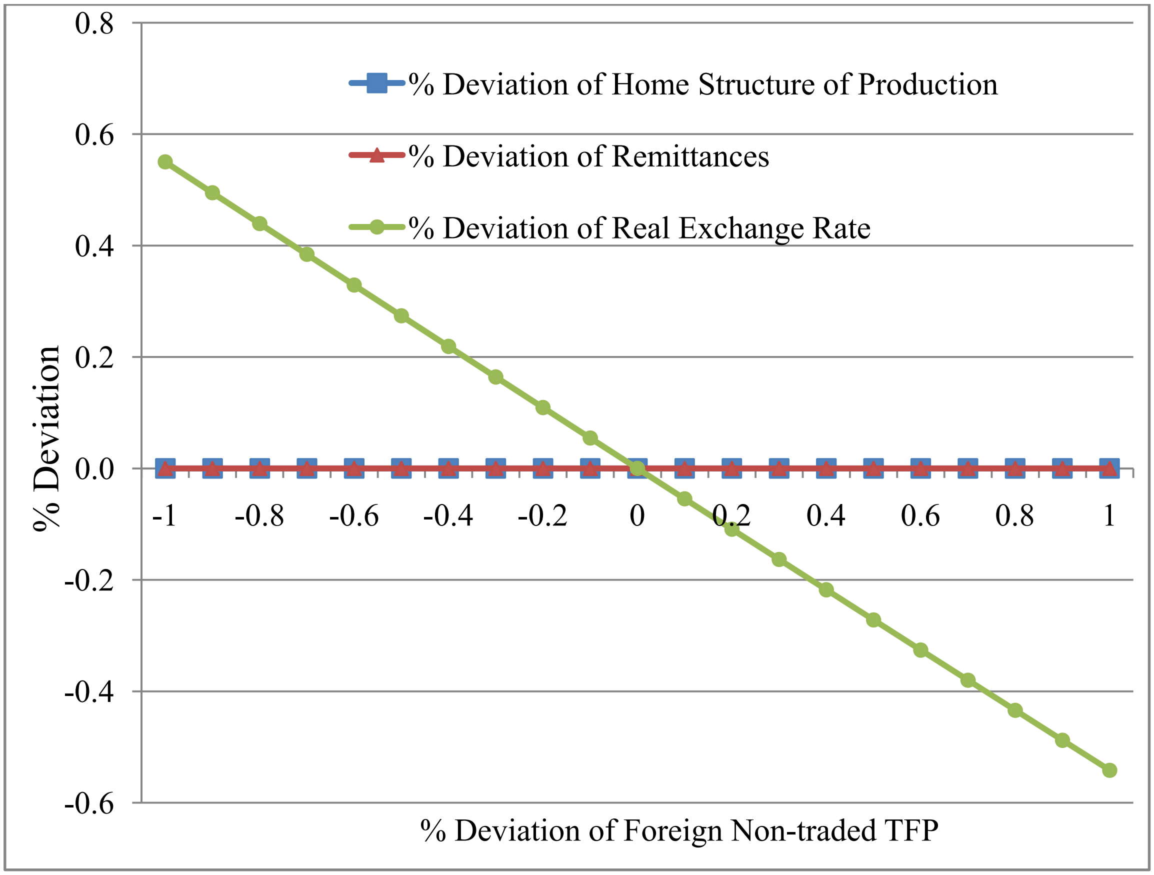


Figure 2

Next, in the altruistic model, an increase in home's traded TFP led to a decrease in remittances decreased, real exchange rate depreciation and more traded goods produced at home. This result contrasts sharply with the result in the overlapping-generations model where remittances stayed unchanged. In other words, with altruism given the current framework and parameters, remittances display a countercyclical pattern relative to the traded sector at home. On the other hand, in the overlapping-generations model (with log utility), remittances do not change in response to key home country variables. In the literature too, altruism and family arrangements are often used to explain occurrences of counter-cyclicality.

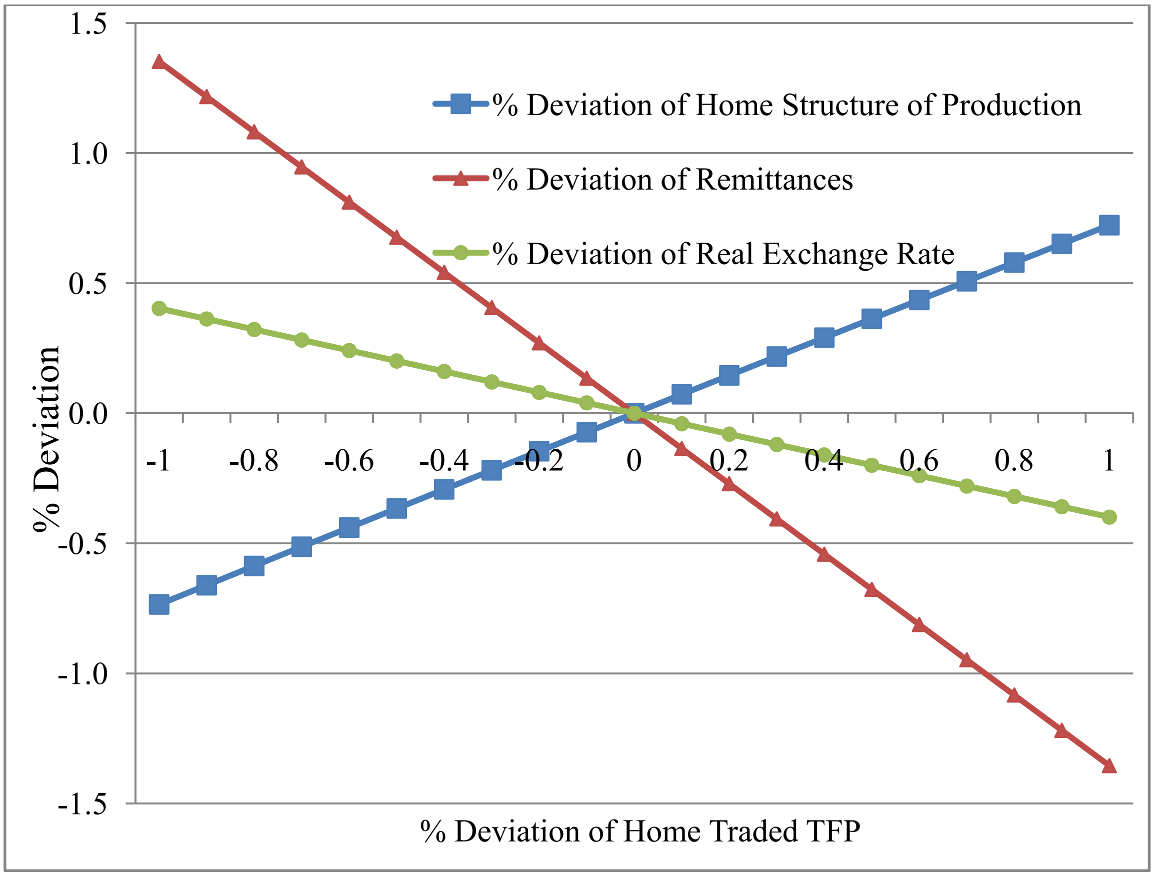


Figure 3

Finally, to conclude the TFP related exercises, home's non-traded TFP was changed. The results obtained thus were no different from the results of the overlapping-generations model. The real exchange rate was positively correlated with the non-traded TFP in both cases while other variables stayed unchanged. Please refer to Figure 4 for the graph.

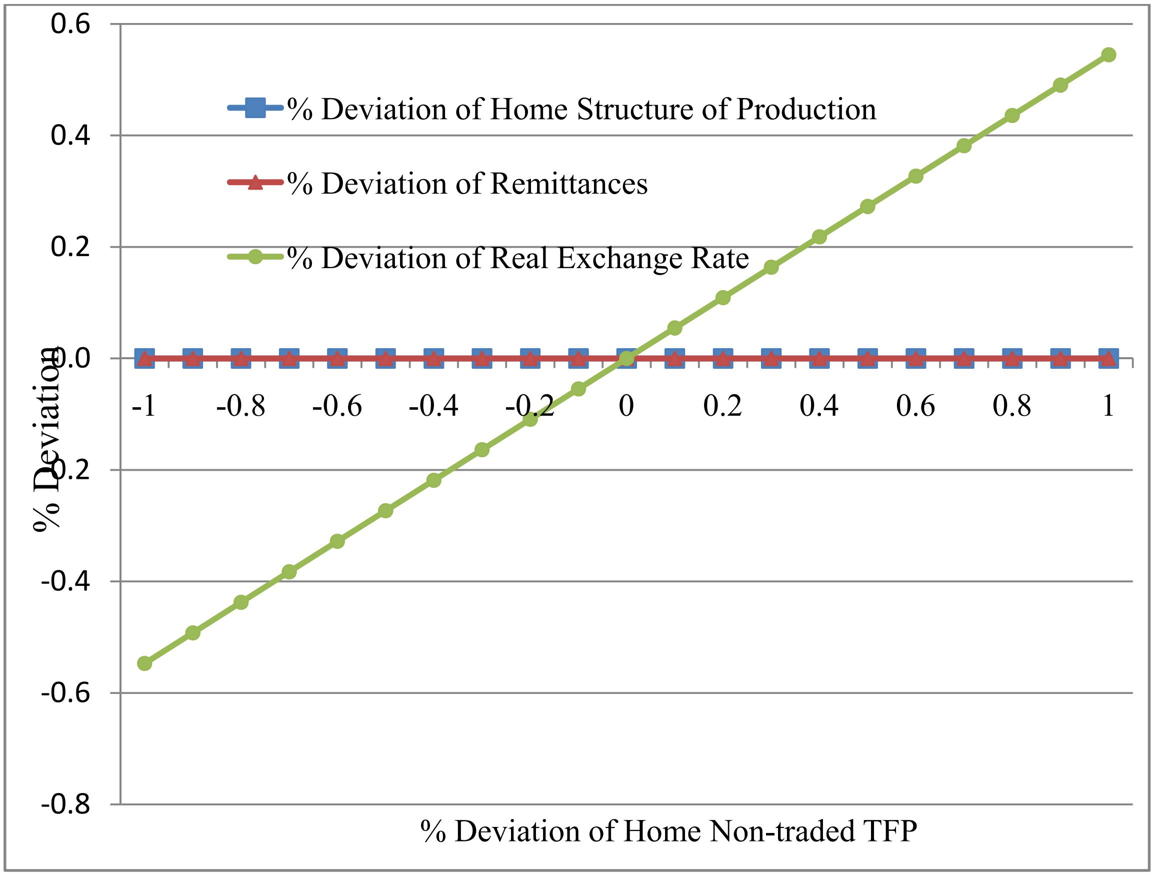


Figure 4

Together, these graphs indicate that in these model setups, remittances do not change with any change in non-traded TFPs. When traded TFP is changed abroad remittances are affected in both models while a change in the traded TFP at home has an impact only in the altruistic case. The real exchange rate appreciates when the foreign traded sector or home non-traded sector becomes more productive. Conversely, the real exchange rate depreciates when the foreign non-traded sector or home non-traded sector becomes more productive. In instances where remittances increase, less traded goods are produced at home and the real exchange rate appreciates as well lending support to the idea of Dutch Disease. The share of the traded sector at home is positively correlated with its own TFP and negatively correlated with foreign traded TFP. The share of the traded-sector does not change with any change in the non-traded TFPs.

The next exercise involved changing 'α', the fraction of home citizens who are migrants. The impact of changing α on the amount remitted by migrants, the real exchange rate and the structure of production are shown in Figure 5. Interestingly, once again, a rise in remittances (caused by increased migration rather than TFP changes) is accompanied by a depreciation of the real exchange rate. At the same time though, there is evidence of Dutch Disease since production at home shifts towards the non-traded sector. However, unlike the overlapping-generations model, remittances rise at a rapidly decreasing rate – and correspondingly, the structure of production and the real exchange rate also do not change as quickly with greater increases in migration. This can be explained intuitively from the fact that when the number of migrants increases, so does their assigned weight in the household level planner's problem. One way to interpret this would be to say that migrants get more say in the household's optimization problem, they remit less.

When remittances increase due to increased migration, there is some evidence of Dutch Disease as the traded sector at home shrinks (even though real exchange rates fall). This corroborates the various empirical and theoretical studies discussed in the previous chapter that raise concerns about Dutch Disease.

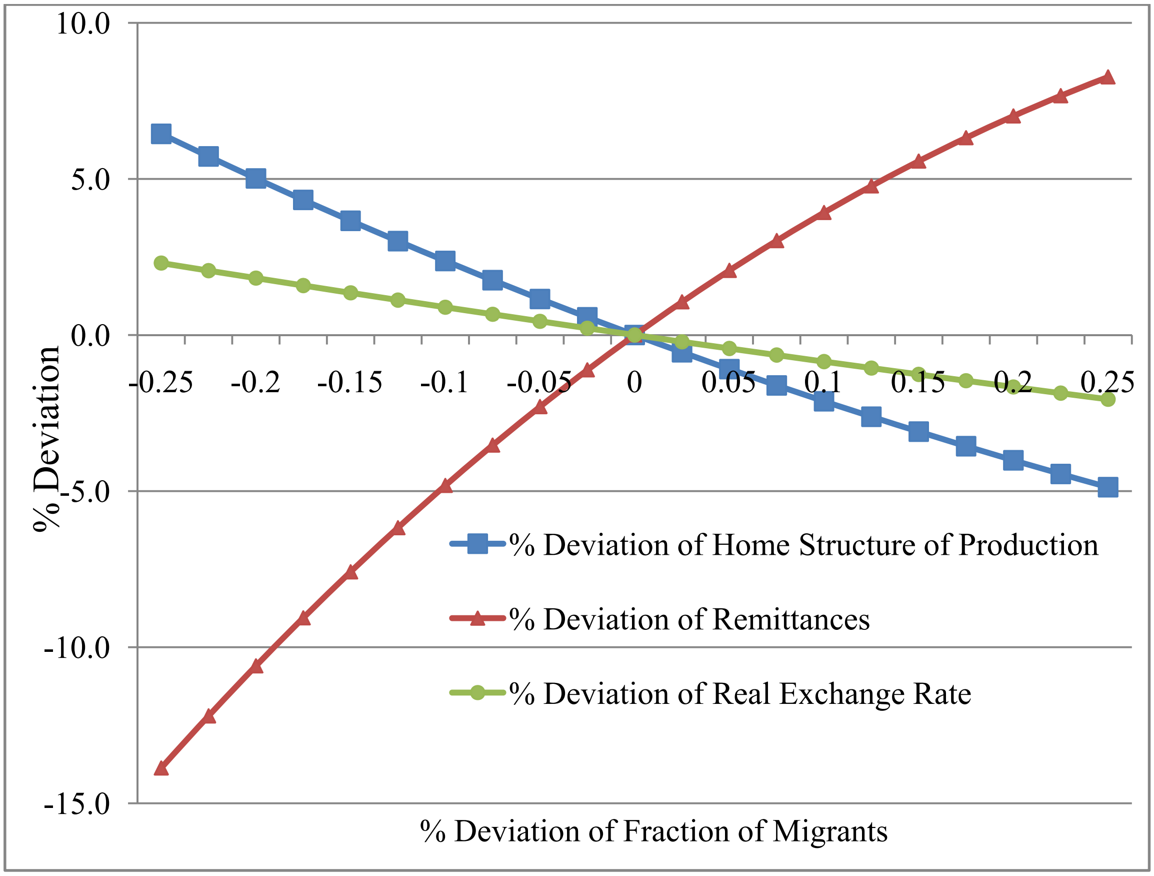


Figure 5

Once again, though as in the previous chapter, on closer examination it can be seen that despite any ill-effects of Dutch Disease, home country welfare increases significantly from increased migration. In fact, unlike the previous overlapping-generations model, even foreign households gain from increased migration (although to a lesser extent). Therefore, aggregate welfare increases as well with increased migration. The magnitude of home welfare gain is much higher than aggregate or foreign welfare gains. These results can be seen in Figures 6, 7, 8 and 9.

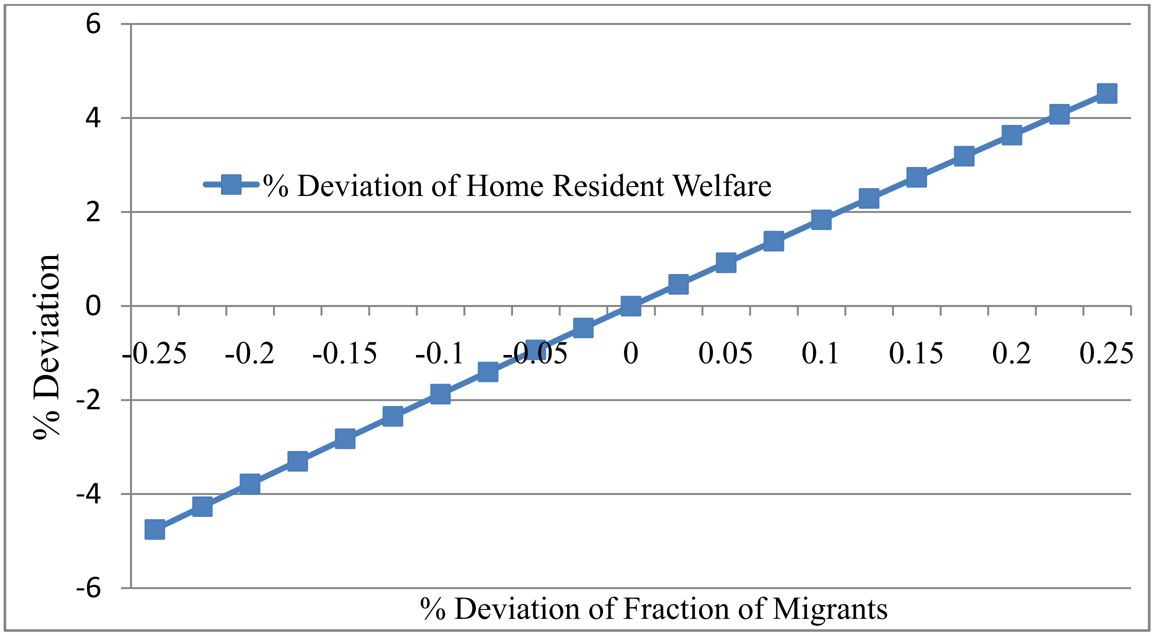


Figure 6

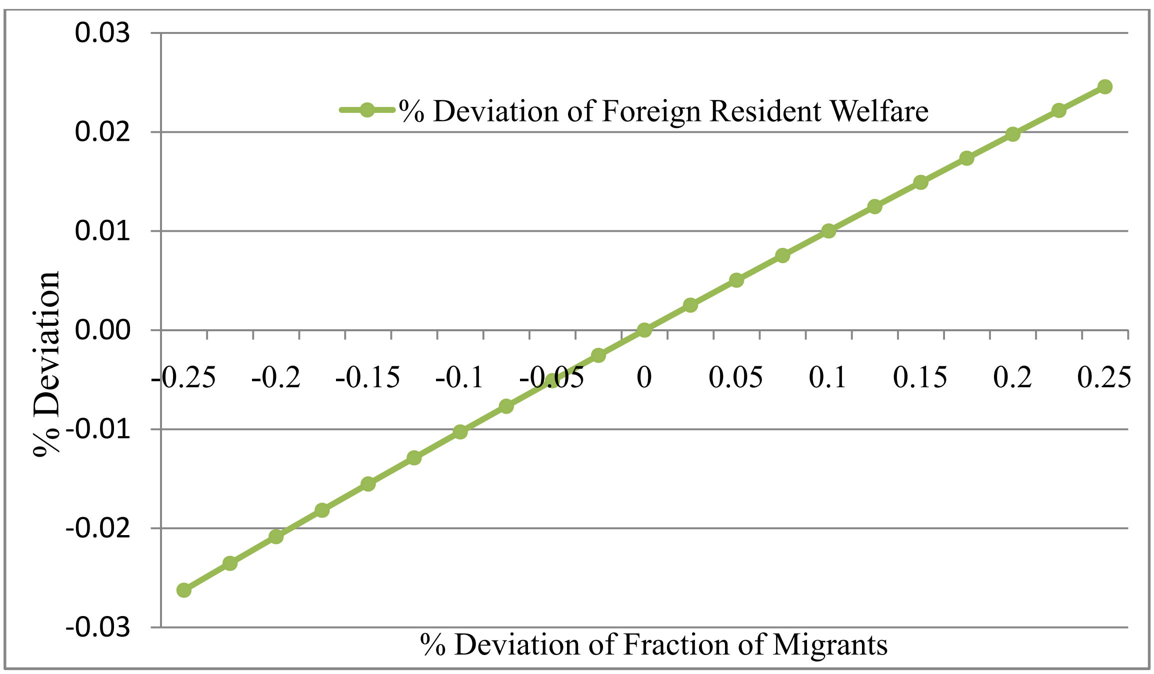


Figure 7

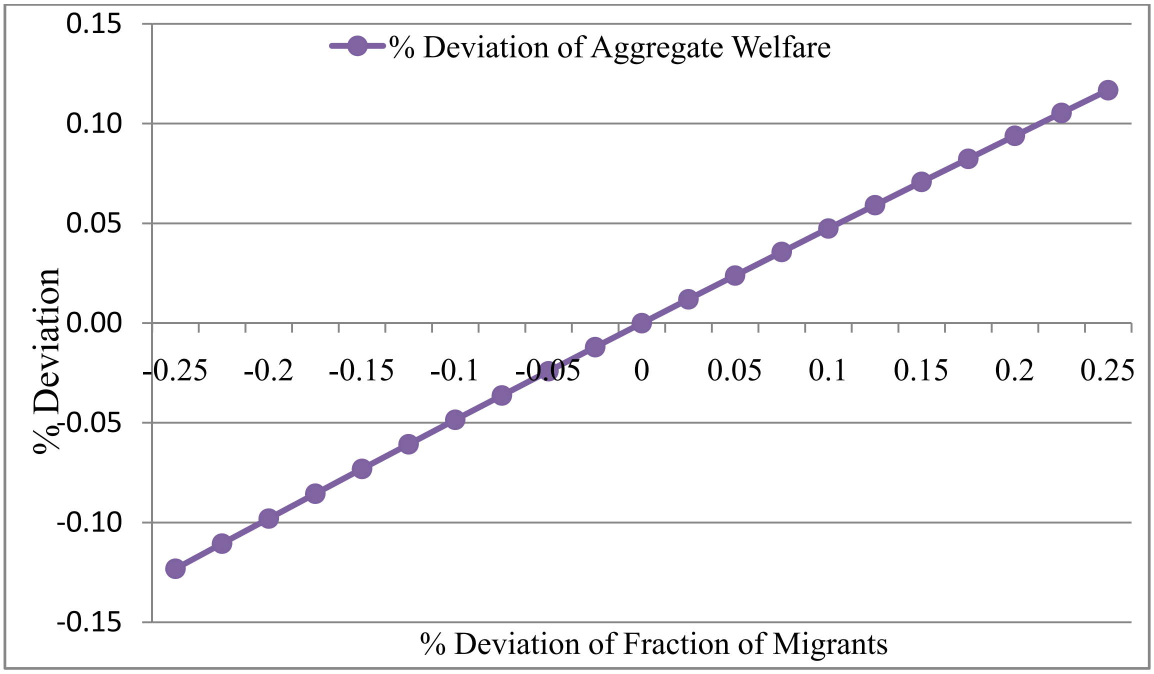


Figure 8

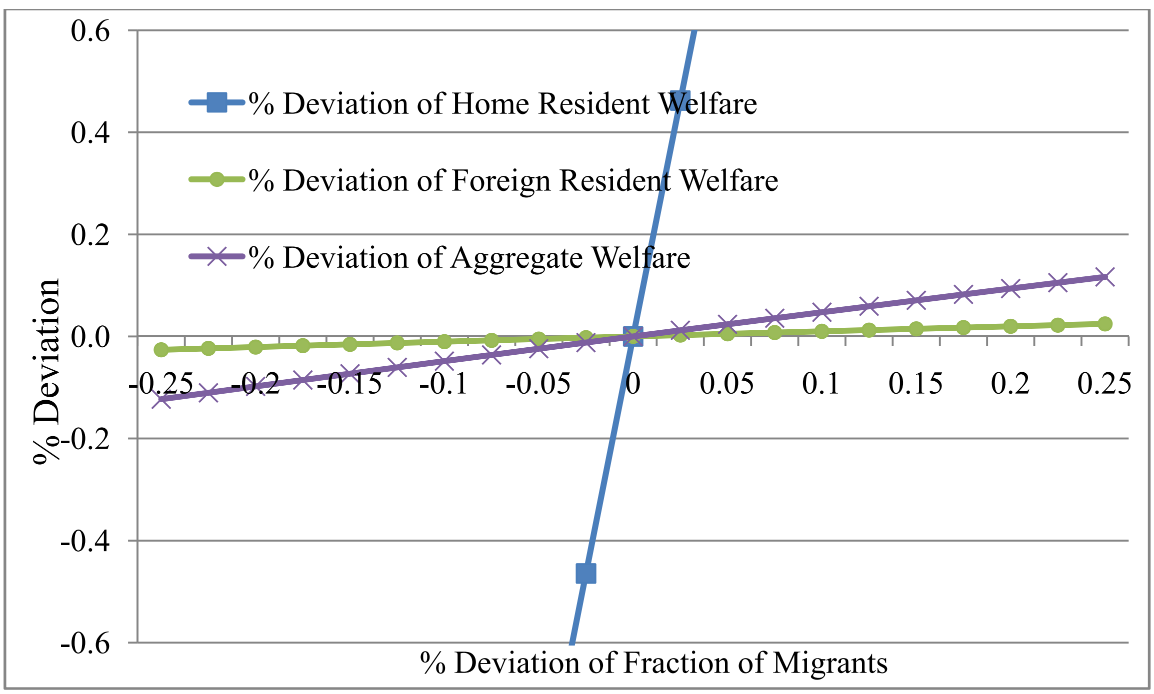


Figure 9

In order to better understand why the model with altruism results in welfare gain for both home and foreign households, the key prices faced abroad are plotted. Figure 10 shows these variables for the overlapping-generations model while Figure 11 portrays the results from the altruistic model.

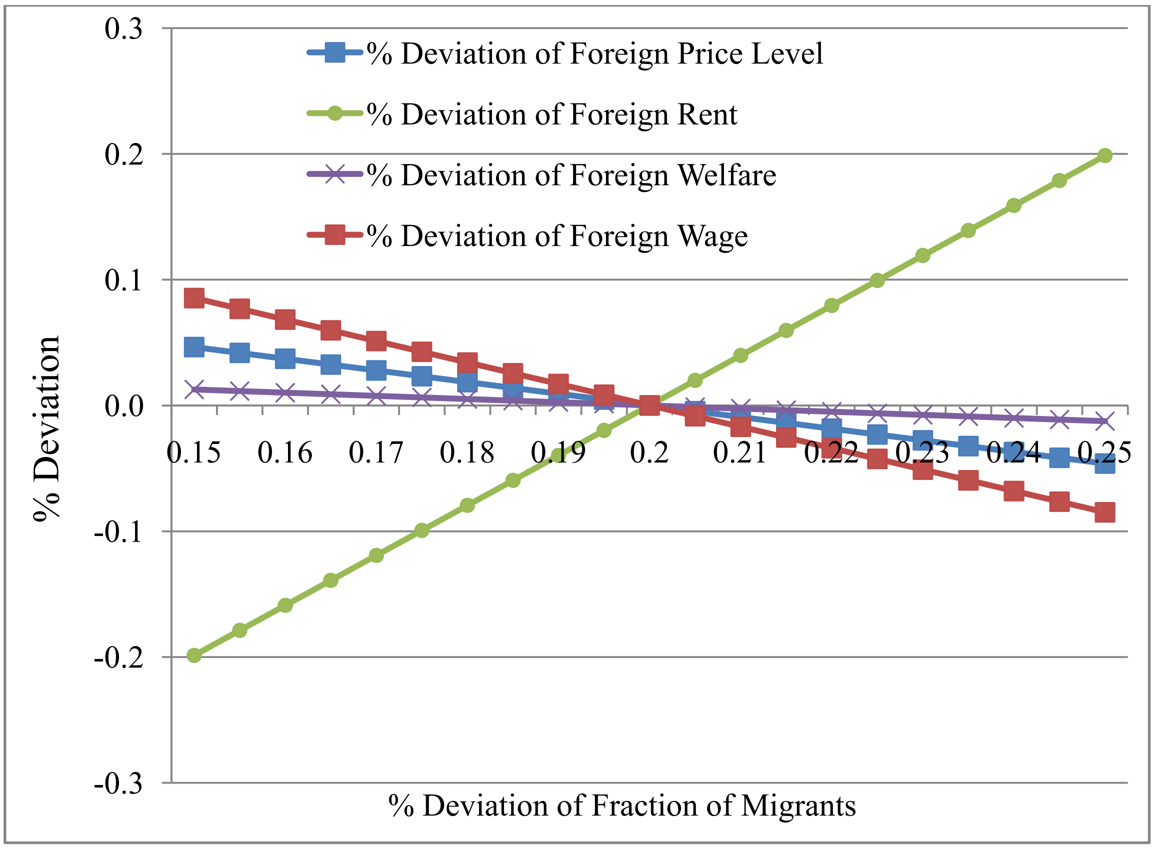


Figure 10 (Note: This result is from the previous chapter)

It can be seen that an increase in migration helps foreign agents by lowering the price level and raising rental incomes. However, in the case of the overlapping-generations models these gains do not offset the loss suffered due to wages depressed by increased migration.

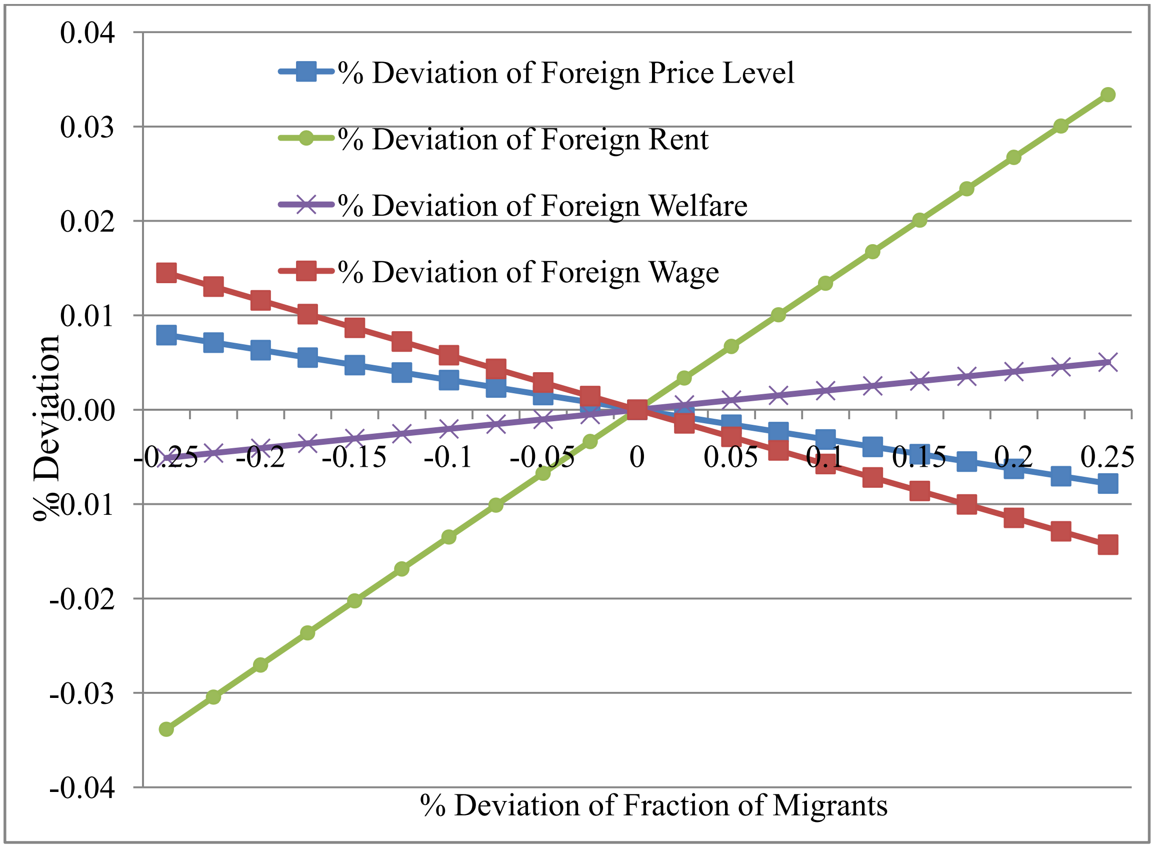


Figure 291

In the model with altruism between migrants and their resident households, once again, increased migration leads to lower prices, higher rental income and lower wages. Unlike the overlapping-generations model, the gains from lower prices and higher rental incomes exceeds the losses from lower wages and increased migration makes even foreign households better off.

The results from the altruistic model also suggest that allowing more immigrant workers from a poor economy might be an effective way to boost the welfare of its households. As with the overlapping-generations model, this was tested using the same counterfactual exercise. When foreign aid is used as a means to help the home (remittance receiving) country instead of allowing migration, residents of the donor country are worse off. Details of this exercise have been presented in the previous chapter and hence are not repeated here. The results (Table 7) show that the welfare of foreign citizens would decrease if foreign aid were used instead of migration to assist the home country.

Decrease in welfare of foreign citizens when aid used instead of migration	3.7%
Percent of traded goods that needs to be transferred as foreign aid	0.3%

Table 4

The altruism model supports the main findings of the overlapping-generations model. Remittances are indeed very effective in boosting the welfare of recipient economies despite any occurrence of Dutch Disease. Additionally, in the altruistic model, remittances are countercyclical with respect to the home country's traded sector TFP. A dynamic model could potentially capture the gains that remittances could provide home households through the channel of consumption smoothing as well.

5.1 The Road Ahead and Future Work

The obvious next step for this work is to solve a dynamic stochastic model that can capture the current benefits of remittances as well as the added gains through consumption smoothing. Adding capital to such a model would provide richer and more accurate dynamics. Another possibility is to model the family's internal optimization problem more explicitly within the current macroeconomic framework. Similarly, the model can be made more realistic by introducing heterogeneity among home agents and allowing migration to become an endogenous decision variable while retaining some of the migration restrictions set by the host country.

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